Zoo
(*_*)

MUSKINGUM RIVER BASIN

TYPE IV SURVEY REPORT

OHIO

U.S. Department of Agriculture

Soil Conservation Service

Economic Research Service

Forest Service

1975

MUSKINGUM RIVER BASIN
TYPE IV SURVEY REPORT

OHIO

Prepared By:

United States Department of Agriculture

Soil Conservation Service

Economic Research Service

Forest Service

In Cooperation With:
Ohio Department of Natural Resources

Under Direction of:
USDA Field Advisory Committee

Columbus, Ohio
1975

TABLE OF CONTENTS

Table of Contents cont'd

Chapter Page

LIST OF TABLES

List of Tables cont'd

Table		Page

LIST OF MAPS

LIST OF FIGURES

Muskingum River Basin

Summary

General

This report presents the findings of the United States Department of Agriculture (USDA) as its part of a comprehensive study of the water and related land resources of the Muskingum River Basin. The study was made in cooperation with the United State Army Corps of Engineers and the State of Ohio. The Corps investigated flood problems, outlets for upstream watershed development, and other development needs. The Department of Agriculture investigated potential upstream watersheds development. The Ohio Department of Natural Resources provided assistance in data collection.

Objectives and Scope of the Study

The Main objectives of the USDA study are to:

1. Inventory the natural resources of the Basin.
2. Analyze the agricultural economy of the Basin as to historic, existing, and projected conditions.
3. Determine the cause, distribution, and magnitude of the Basin's water and related land resource problems.
4. Determine the present and future development needs based on resource problems and projected economic activity.
5. Describe the pertinent existing water and related land resource projects and programs.
6. Describe the physical potential or capability of the Basin to meet identifiable water and related land resource development needs.
7. Describe the opportunities for development through USDA projects and programs and estimate their impacts.

The projections throughout this report are based upon expected population growth and economic development for the years 1980, 2000, and 2020.

Size and Location of the Basin

The Muskingum River Basin is located in Eastern and Southeastern Ohio. The Muskingum River, a tributary of the Ohio River, is formed by the confluence of the Walhonding and Tuscarawas Rivers at Coshocton. The Muskingum flows for approximately 112 miles to its confluence with the Ohio River at Marietta, Ohio. The headwaters of the Tuscarawas and Walhonding Rivers rise near Akron and Shelby, Ohio, respectively. The drainage area of the Basin is 8,051 square miles, being approximately 20 percent of the state's total area. The Basin includes all of five and portions of 22 counties. (See Basin Map for outlined boundary.)

Problems and Needs

The major problems and needs within the Basin directly associated with water and related land resources are:

1. Floodwater Damage. Although many of the major flood hazards in the Muskingum Basin have been eliminated by the existing reservoir system and by local protection works, a number of serious problems still exist. Approximately 237,300 acres are subject to flooding. Floodwater damages are induced on agricultural lands, urban areas, and to road and bridges. Crop and pasture damages are estimated to be over $1.33 million and nonagricultural damages to be over $1.48 million annually.

2. Erosion and Sediment Damage. Erosion and sedimentation constitute damage problems to both agricultural and urban properties as well as other land resources. Sheet erosion is the major type of erosion in the Basin and produces the greatest quantity of sediment. An estimated 109,000 acres or 2.1 percent of the Basin has erosion damage. Sediment concentration and accumulation from erosion causes direct damage to stream channels, croplands, water quality, and urban structures. Approximately 622,965 tons of sediment is yielded at the mouth of the Muskingum River annually or about 2.6 percent of the average annual gross erosion.

U. S. DEPARTMENT OF AGRICULTURE

MUSKINGUM RIVER BASIN

OHIO

SOURCE
1/250,000 USGS QUADRANGLES, 15 MINUTE USGS TOPOGRAPHIC
QUADRANGLES, 1/500,000 OHIO BASE MAP AND THE 1973
STATE HIGHWAY MAP

TRANSVERSE MERCATOR PROJECTION

1-30-74
5,R-32,783

3. Impaired Drainage. The 1971 Conservation Needs Inventory shows that 295,500 acres of cropland need drainage type measures. Both tile and open ditch drainage are needed to maximize production of agricultural products. Poor maintenance of existing outlets has caused presently installed drainage systems to function inefficiently.

4. Rural Water Supply. In certain areas in the southeast third of the Basin underground sources of water are inadequate thus requiring cistern, pond, or community developments. The 1966 Conservation Needs Inventory states that 3,509 farm households have inadequate water supplies. In addition, 2,440 nonfarm households have the same problem.

5. Recreation. Major recreational problems at the present are inadequate accesses to existing water, particularly in streams and rivers, and insufficient support facilities where extensive recreational areas exist. Problems are expected to exist under present level of development in all water and water associated recreational activities.

6. Water Quality. The largest type of agricultural pollution is sedimentation. Other sources of pollution originate from strip mine and construction areas. Organic pollution in the Basin is also a problem. Pollution from various sources adversely affects the many water uses.

7. Forest Management. A need for forest management exists within the Basin. Erosion occurs on 32,000 acres.

Finding and Conclusions

The report presents four alternative early action programs. Each is presented to provide flexibility in making decisions for implementing the comprehensive Basin plan. All alternatives will require reorientation of program goals toward accomplishment of the Basin plan. Alternative I is a program designed to meet the most clearly defined present needs and can be accomplished under present authorities and funding. It proposes installation of land treatment measures on

1,199,300 acres of agricultural land. The estimated land treatment costs under Alternative I would be $30,337,900. Approximately $6,473,200 would be borne by federal funds and $23,864,700 by local funds. Nine watershed projects include 44 structures and 43 miles of channel work. Eleven of these structures are multiple purpose. Total average annual benefits from the nine watersheds is estimated at $2,807,500. Total estimated installation cost is $26,770,300.

Alternative II attempts to meet every identified need for water resource development. Existing programs and policies were not considered a constraint. Eight watersheds are included for flood prevention purposes only. Total installation cost is estimated at $19,535,300. Average annual benefits from the eight watershed projects would be $1,732,900.

Another twelve reservoirs would be installed for municipal and industrial supply. Installation costs would total about $11,479,900. The accelerated land treatment program in Alternative I would also be initiated under this Alternative.

Alternative III is a nonstructural program with the minimum input under current program authority. It includes a subsidized land treatment program with federal funding in excess of going USDA program costs. The estimated cost for carrying out such a program on approximately 1,888,900 acres would be $49,330,000. This Alternative proposes purchase of agricultural land flooded by the two year event. Approximately 104,900 acres would be purchased, at an average value of $450 per acre, for a total cost of $47,200,000. Where development is currently located in the flood plain, flood hazard studies are proposed. Thirty-nine such studies are requested for communities in the Basin at an estimated cost of $9,000,000. The total estimated cost for Alternative III is in excess of $105 million.

Alternative IV would represent the most comprehensive planning program considered. The program would divide the Basin into three generalized areas according to resource potential and existing development trends. This Alternative includes the same accelerated land

treatment program set forth in Alternative III along with 39 flood hazard studies. The structural aspects includes twelve water supply reservoirs and three watershed projects formulated to provide flood protection to the agricultural land. The recreation potential would be in two of the watersheds. Total cost of this Alternative is estimated to be over $81.7 million.

A short range plan is recommended while a long range plan is formulated. Suggested installation period of the short range plan is the next five years. The plan includes accelerated land treatment on 484,500 acres at an estimated cost of $12,245,200. Six flood hazard studies are recommended at a cost of $1.6 million.

Buffalo Creek and Chippewa Creek are authorized for construction and represent a total installation cost of over $4.5 million. Total average annual benefits are nearly $300,000. The South Fork of Licking River is authorized for planning. It is recommeded that these projects be continued.

Chapter 1

INTRODUCTION

MUSKINGUM RIVER BASIN

Chapter 1. Introduction

A. General Description of the Basin

B. Authority

C. Participants

D. Needs and Objectives

E. Investigations

F. Use and Value of the Report

G. Acknowledgements

A. General Description of the Basin

The headwaters of the Muskingum River originate near the city of Akron in Northeastern Ohio, within 25 air miles of Lake Erie. It flows generally south to its junction with the Ohio River at Marietta, Ohio. North-south the drainage area is about 120 miles long and east-west is 95 miles across at its widest point with a total of 5,152,640 acres (8,051 square miles). The area includes all or part of 27 counties in eastern and southeastern Ohio.

Land use within the Basin is presently 39 percent cropland, 36 percent forest land, 20 percent pasture and five percent other lands.

The largest city wholly within the Basin is Canton, Ohio, with a population of over 110,000. Just 25 miles to the northwest, located on the watershed divide, is the city of Akron, with a metropolitan population of over 300,000 people. There are 25 cities with populations exceeding 5,000 located all or partly in the Basin.

B. Authority

The Department of Agriculture is participating in this study at the request of the Corps of Engineers and under authority of Section 6 of the Watershed Protection and Flood Prevention Act. (Public Law 566, 83rd Congress, 68 Stat.) as amended. Section 6 authorizes the Secretary of Agriculture in cooperation with other Federal, State, and local agencies to make investigations and surveys of watersheds and rivers as a basis for developing coordinated programs.

Planning policies and investigational procedures are based on Departmental interpretation of the requirements set forth in Senate Document 97-87th Congress, 2nd Session.

C. Participants

The survey and report preparations were carried out by U.S. Department of Agriculture personnel of the Soil

Conservation Service, Forest Service, and the Economic Research Service. General direction was received from a Field Advisory Committee composed of representatives of the three agencies. The Soil Conservation Service representative served as Chairman of the Committee. Further assistance was received from the Southeast Ohio Advisory Council. This group includes representatives from the same agencies plus assigned personnel from the State and for the State of Ohio was provided by the Department of Natural Resources.

D. Needs and Objectives

The primary objective of the study was to prepare a long-range plan that would facilitate the orderly development, use and management of the water and related land resources of the Basin.

An appraisal was made of the present and projected agricultural and rural community water and related land resources problems and the needs for development of these resources. In this study, consideration was given to erosion control and sediment reduction, flood prevention in upstream areas, flood hazards to developed areas, impaired drainage, water supply needs in rural and upstream areas, conservation treatment of cropland and pasture, forest management and treatment, outdoor recreation, fish and wildlife, and water quality control.

The potential for water and related land resource development and management in upstream watersheds was analyzed as were the alternatives and opportunities in these areas for solving the problems and meeting the needs. This included consideration of capabilities and treatment needs of the land resource, the potential for water storage, channel improvement, and other structural and non-structural measures, and the need for upstream watershed projects.

Community development needs to be strengthened by coordinating agricultural and forest production, industrial growth, and recreational development. The objective of

this development is to raise personal incomes and enhance environmental quality. A major consideration is to protect and/or develop the resource base so that the economic and social conditions are maintained at a level consistent with the regional desires.

Further, the formulations considered programs to promote economic growth and development consistent with national objectives. The components of the program are aimed toward contributing to the satisfaction of current and long-term needs and promoting efficient utilization of all resources.

E. Investigations

Information from existing reports of previous studies and general data from various Federal, State, and private sources, was used to the extent it was available. This included the 1967 USDA Conservation Needs Inventory, the Ohio River Basin Comprehensive Survey and the 1969 Census of Agriculture. Information was also obtained from maps, photo studies, and field reconnaissance and surveys.

The Basin has been divided into four economic sub-areas along county boundaries as shown on Map 1-1. These economic sub-areas encompass all of 19 counties. This is an area somewhat larger (+1,576 square miles) than the drainage area of the Basin which includes all of five and portions of 22 counties.

The Basin was divided into 14 hydrologic study areas for more detailed analysis. Map 1-2 for locations. Also see Table 2-1 for hydrologic names and information.

These hydrologic study areas were studied in sufficient detail to identify the intensity and extent of flood and water management problems.

Valley and channel cross-sections for flood routing purposes were surveyed in each watershed which indicated a short-ranged development potential.

MAP 1-1

ECONOMIC SUBAREAS
MUSKINGUM RIVER BASIN
OHIO

SOURCE:
FAMILY OF MAPS SCS DRAWING NO.
5,R-32,783 (1-30-74) AND INFORMATION
FROM FIELD TECHNICIANS. TRANSVERSE
MERCATOR PROJECTION.
USDA-SCS-LINCOLN, NEBR. 1974

7-12-74
5,N-34,350

HYDROLOGIC STUDY AREAS

MUSKINGUM RIVER BASIN

OHIO

MAP 1-2

SOURCE: FAMILY OF MAPS SCS DRAWING NO. 5,R-32,783 (1-30-74) AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION.

USDA-SCS-LINCOLN, NEBR 1974

9-12-74
5,P-34,351

The information gathered was used in the hydrology and economic computer programs to evaluate damages and benefits. Full use was made of aerial photographs and topographic and other maps, such as those used in the Ohio River Basin comprehensive survey studies, in the inventory of potential sturcture sites. The more promising structure sites were checked by field reconnaissance.

The economic subareas were utilized for the collection of data and the analysis and study of production and other aspects of the agricultural economy and developments. The subareas encompass major trade centers and standard Metropolitan Statistical Areas having similarities in industrial, manufacturing, agricultural, and retail trade activities. Economic Subarea 1 includes the Upper Tuscarawas River, most of Sandy Creek, the upper half of Killbuck Creek, and the upper part of the Sugar Creek hydrologic subareas. Area 2 includes Mohican River, Kokosing River, and the Licking River. Area 3 includes the lower half of Killbuck Creek, most of Sugar Creek, Conotton Creek, most of Stillwater Creek, and the local drainage areas of the lower Tuscarawas and Walhonding Rivers and upper Muskingum River. The Economic Subarea 4 includes the rest of the local drainage into the Muskingum River and Wills Creek and the Licking River hydrologic subareas.

F. Use and Value of the Report

The information presented in this report can be used by county and city governments, soil and water conservation districts, conservancy districts, planning commissions other local groups in planning land use, developing budgets and setting priorities for expenditure of funds, early acquisition of needed reservoir areas, recreational developments and other improvements. Those with responsibility for planning transportation, public utility systems, water and sewer districts, and recreational developments can minimize conflicts by considering the locational developments of water and related land resources recommended in the comprehensive basin plan.

The report can be helpful in long-range planning by state government divisions for parks, fish and wildlife developments, water resources, forestry programs, wild and scenic river projects, environmental aspects, and other natural resource developments. The report provides recommendations and information useful to both state and federal agencies and officials in setting priorities for resource use and development. The U.S. Department of Agriculture can use the report as the basis for directing its efforts in cooperation with soil and water conservation districts, other government agencies, watershed groups and other resource development groups.

Information pertaining to water and related land resources can assist land developers and commercial interests to select suitable development sites.

G. Acknowledgements

Cooperation, data, and assistance for the U.S. Department of Agriculture Report were provided by the following local, State, and Federal Agencies:

U.S.D.A. Agricultural Research Service
U.S.D.A. Agricultural Stabilization & Conservation Service
U.S. Army Corps of Engineers
U.S. Bureau of Census
U.S. Bureau of Mines
U.S. Bureau of Outdoor Recreation
U.S.D.A. Cooperative Extension Service
U.S. Environmental Protection Agency
U.S.D.A. Farmers Home Administration
U.S. Fish and Wildlife Service
U.S. Geological Survey
Ohio Department of Natural Resources
Ohio Department of Health
Ohio Department of Development
Ohio Environmental Protection Agency
Muskingum Conservancy District
The Ohio State University

Chapter 2

RESOURCES OF THE BASIN

MUSKINGUM RIVER BASIN

Chapter 2. <u>Resources of the Basin</u>

A. Description
   1. Location in State
   2. Counties
   3. Size
   4. Relation to Other River Systems

B. Climate (Averages, Extremes and Variations)
   1. Precipitation
   2. Temperature
   3. Growing Seasons

C. Physiography and Geology
   1. Topography
   2. Geology
   3. Soils
   4. Minerals
   5. Natural Features (Lakes, Hills, etc.)

D. Land Resources
   1. Land Resource Areas and Soil Suitability
   2. Supply and Geographic Distribution
   3. Vegetation
   4. Use and Management

E. Water Resources
   1. Water Yield
   2. Geographic and Seasonal Distribution
   3. Water Quality
   4. Ground Water
   5. Water Use and Management

F. Fish and Wildlife Resources

   Game and Commercial Species (Habitat availability, conditions, and other factors.)

G. Outdoor Recreation Resources
   1. Location
   2. Facilities Available
   3. Remarks

H. The Natural Environment
   1. Scenic Beauty
   2. Destructive Factors

Muskingum River Basin is rich in
existing recreation resources.

Agriculture, a major industry in the basin.

Typical strip mine operation in
the southern portion of the basin.

A. Description

The Muskingum River Basin is situated wholly within the State of Ohio, and covers 8051 square miles, or about one fifth of the total state area. The basin is about 95 miles wide from east to west and about 120 miles long from north to south, and extends to within 25 miles of Lake Erie. The Muskingum River Basin comprises about 27 percent of the Ohio portion of the Ohio River drainage basin.

Two main tributaries, the Mohican and Tuscarawas Rivers flow southward from Mansfield and Akron in the northwest and northeast corners of the basin respectively. The Kokosing River joins the Mohican River near Walhonding forming the Walhonding River which flows eastward to Coshocton. The Tuscarawas River to the east turns westward to Uhrichsville, meeting the Walhonding River at Coshocton. This confluence forms the Muskingum River which flows generally southward emptying into the Ohio River at Marietta. A map showing the principal streams of the Basin are shown as Map 1-2. The principal streams are also listed in Table 2-1.

All of five, and parts of 22 additional counties in the Muskingum River Basin Drainage Area. (See Table 2-2)

Key elevations and slopes of the principal Muskingum River Basin streams are given in Table 2-3.

Table 2-3

River	Elevation (Feet above m.s.l.) (Source)	(Mouth)	Length (Miles)	Avg. Fall (Ft/Mile)
Mohican	923	819	27.6	3.8
Kokosing	1,308	819	57.2	8.5
Walhonding	819	738	23.5	3.4
Tuscarawas	1,140	738	129.9	3.1
Muskingum	738	585	111.9	1.3

The Basin's total 1970 population is estimated to be 1,800,000 of which 750,000 are classified as urban. The

Table 2-1

Hydrologic Tributaries of the Muskingum River

Sheet 1 of 2

	Hydrologic Tributary	Drainage Area Sq. Miles	General Direction of Flow
I.	Sandy Creek	424	Flows southwest from New Alexander, through Minerva Malvern, Waynesburg, and Magnolia, then goes northwest to the junction with the Tuscarawas River near Boliva in Tuscarawas County.
II.	Conotton Creek	300	Starts at the headwaters above Jewett, flows generally northwest through a number of small towns, then joins the Tuscarawas River at Zoarville in Tuscarawas County.
III.	Sugar Creek	345	Flows southeast from Smithville to its junction with the Tuscarawas River near New Philadelphia in Tuscarawas County.
IV.	Upper Tuscarawas	528	Flows south from Akron, Barberton Area through Massillon and cuts southwest in Tuscarawas County, then southwest to New Philadelphia.
V.	Stillwater Creek	473	Flows generally northwest through Freeport and Tippicanoe to its junction with the Tuscarawas River at Midvale (near Uhricksville) in Tuscarawas County.
VI.	Mohican River	995	Flows from Shelby southeast past Mansfield to Loudonville, where it turns south and goes to Walhonding and joins the Kokosing River to form the Walhonding River. (Coshocton County)
VII.	Kokosing River	516	Flows east to Fredericktown, South to Mount Vernon, then east to Walhonding where it joins the Mohican River and forms the Walhonding River. (Coshocton County)

Table 2-1
Hydrologic Tributaries of the Muskingum River

	Hydrologic Tributary	Drainage Area Sq. Miles	General Direction of Flow
VIII.	Killbuck Creek	654	Flows generally south from Burbank, through Wooster and Millersburg and joins the Walhonding River near Randle in Coshocton County.
IX.	Wills Creek	904	Flows in a northerly direction through Cambridge to Kimbolton, then goes west to its junction with the Muskingum River near Adams Mills in Muskingum County.
X.	Licking River	760	Includes five tributaries; Rocky Fork, North Fork, Long Pond Run, Raccoon Creek, and South Fork. All join near Newark and flow generally east or southeast to the junction with the Muskingum River in Zanesville. (Muskingum County)
XI.	Wakatomika Creek	249	Flows southeast from near Gambier to Frazeysburg, then northeast to Dresden to the junction with the Muskingum River in Muskingum County.
XII.	Jonathan Creek	291	Flows north through Thornville, then east to join Moxahala Creek, turns northeast to empty into the Muskingum River near Zanesville in Muskingum County.
XIII.	Wolf Creek	257	Flows northeast to the junction with the Muskingum River at Beverly in Washington County.
XIV.	Muskingum (Local)	1,355	Includes: The Tuscarawas River drainage from New Philadelphia southeast to Uhrichsville then southwest to Newcomerstown and west to Coshocton; the Walhonding River drainage from the junction of the Kokosing and Mohican Rivers southeast to Coshocton where the Walhonding River joins the Muskingum River; The Muskingum River flows south to Zanesville, east to Philo, then southeast to Marietta where it empties into the Ohio River.

Table 2-2

Counties in Muskingum River Basin

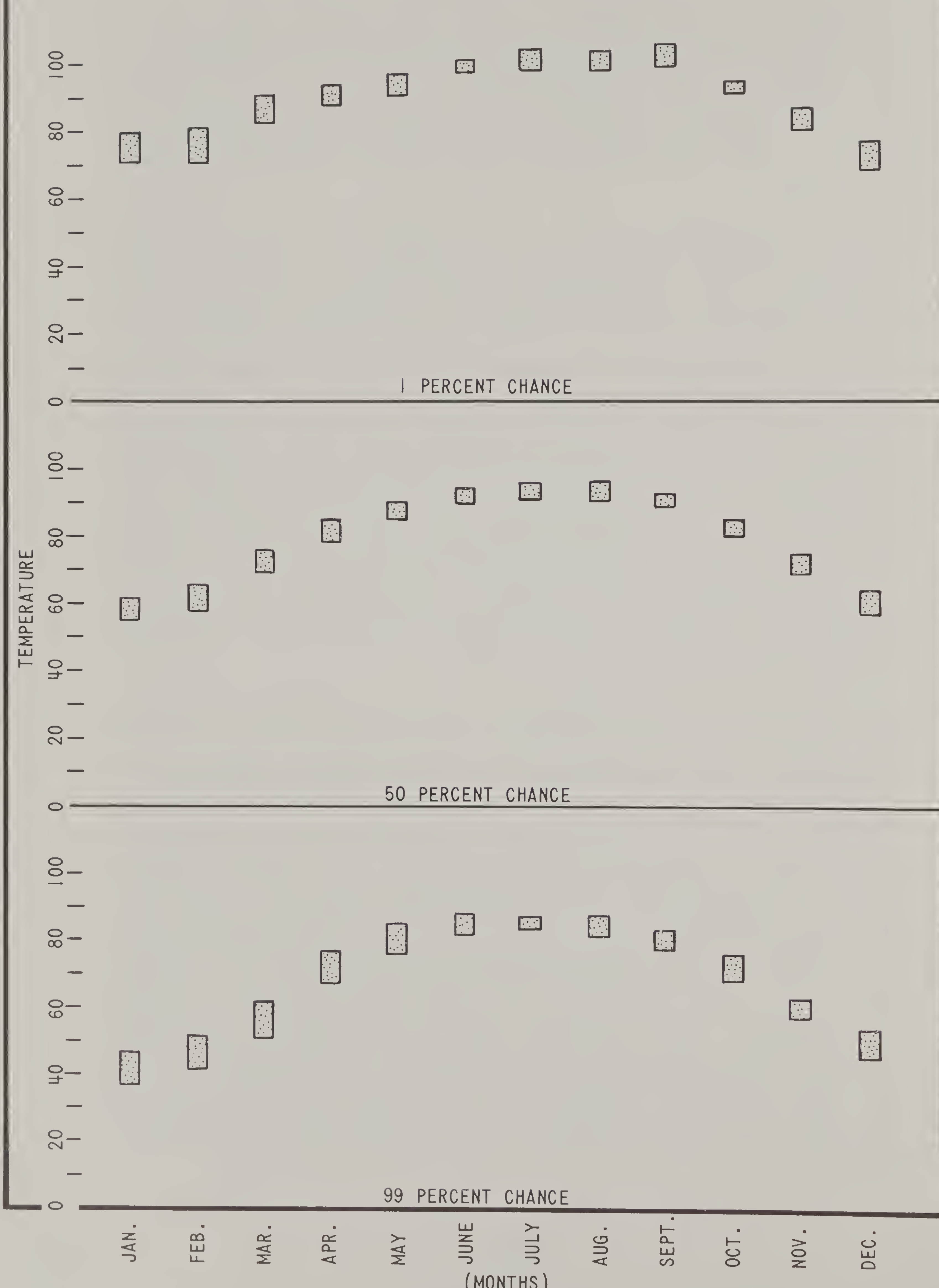
County	Percent Within Basin	Square Miles
Ashland	82.2	335
Athens	0.6	4
Belmont	21.7	118
Carroll	79.3	333
Columbiana	9.7	51
Coshocton	100.0	574
Crawford	1.5	6
Fairfield	4.1	19
Guernsey	99.2	540
Harrison	73.2	317
Holmes	100.0	452
Knox	98.9	538
Licking	93.7	626
Medina	33.9	140
Monroe	8.6	41
Morgan	83.1	383
Morrow	34.6	150
Muskingum	100.0	691
Noble	52.2	219
Perry	43.2	171
Portage	0.4	2
Richland	88.2	443
Stark	87.6	423
Summit	37.5	91
Tuscarawas	100.0	588
Washington	34.6	230
Wayne	100.0	566
TOTAL		8,051

extreme low temperatures which have probabilities of occurrence on the average of not more than 1, 50, and 99 times in 100 years. Figure 2-2 gives the information for extreme high temperatures. In July, on the average of one year in two the temperature will reach between 90 and 95 degrees depending on the location within the Basin. The shaded area represents variations within the Basin.

Wind, temperature, and vapor pressure control rate of evaporation from water surfaces. Although large variations in evaporation rates occur with time, the main interest is in total yearly water losses. The United States Weather Service has installed standard Class A evaporation pan gages. These records are used to estimate evaporation loss from lakes. The ratio of evaporation from a broad water surface to that of a class A pan is found to range from .6 to .8. Another problem in relating pan losses to total lake evaporation losses is frozen conditions during winter months. Pan records are available only for summer months. Studies have been made using published weather bureau records of wind movement, solar radiation and vapor pressure to calculate evaporation. After performing the required adjustments on pan readings the mean annual reservoir loss is approximately 34 inches.

Most of the moisture which falls as rain or snow over the Basin has its origins from the oceans. It is estimated 12-14 percent of the atmospheric moisture is acquired over land as air masses move from west to east. Passage of cold or warm fronts and their associated centers of low pressure occur frequently and precipitation often results. Precipitation is mainly of two types: convectional or thunderstorm and the cyclonic. The convectional or thunderstorm is characterized by heavy showers of short duration. This type of precipitation may be associated with the passing of an "active" front or may occur as "air mass thunderstorms" during the hottest part of the day in summer. Tornadoes occasionally accompany convectional precipitation. In cyclonic precipitation rain fall occurs irrespective of the time of day, usually lasts longer, and the rate of fall is not as heavy as that of convectional precipitation.

Figure 2-2
EXTREME HIGH TEMPERATURE
WITH PROBABILITY EQUAL OR LESS THAN



five principal cities (Canton, Massillon, Mansfield, Newark, and Zanesville) include about one half of the urban population. Cleveland, Ohio's largest city, is located about 20 miles north of the Basin's northern boundary.

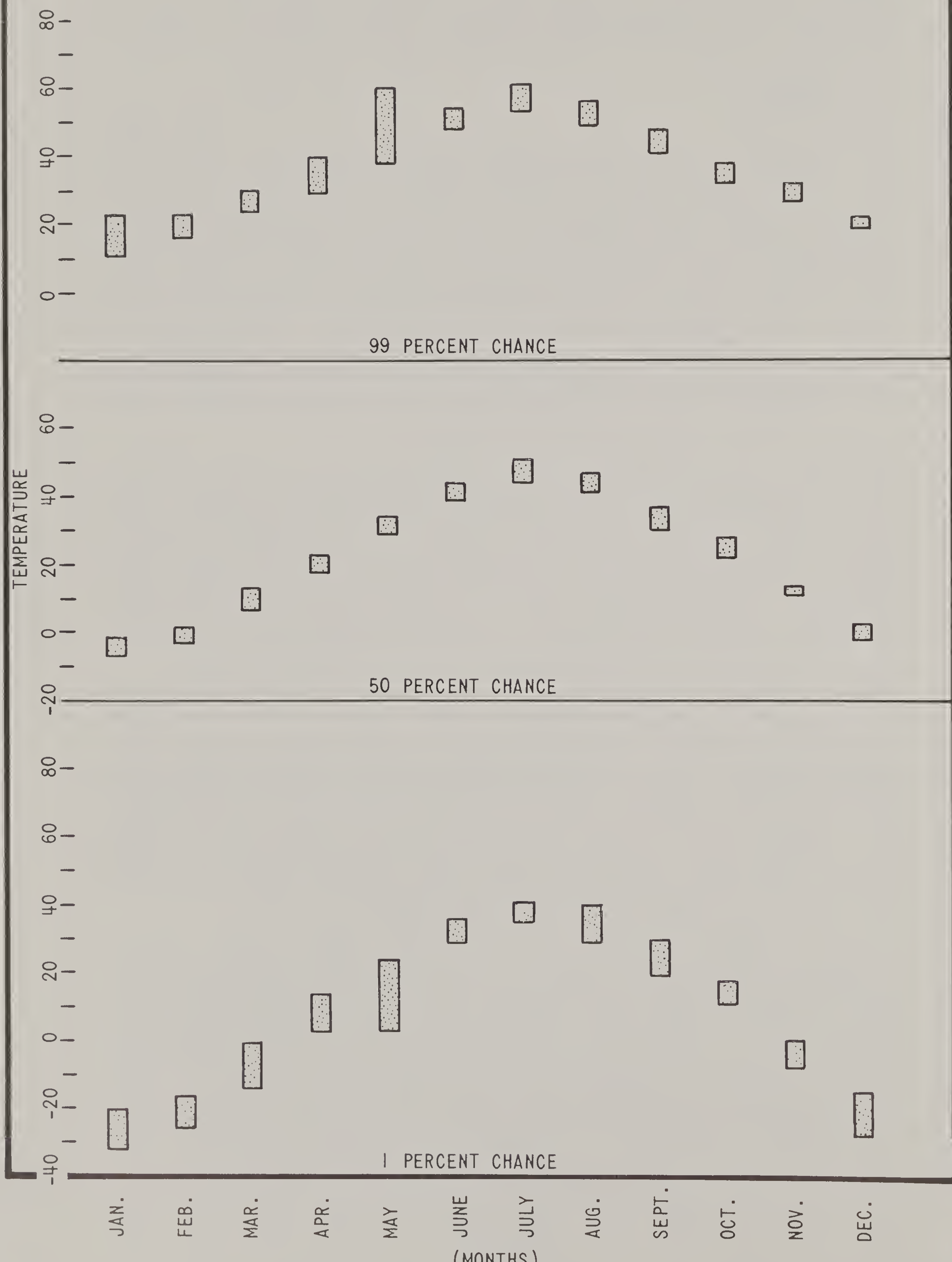
B. Climate

The climate of the Muskingum River Basin is classified as humid with warm summers and mildly cold winters. Many factors interact to influence the climate as it varies with the season. Location of the Basin between latitudes 39.5 and 41 degrees, its altitude above mean sea level, and its location, with respect to large bodies of water, are the predominant influences on normal or average weather conditions. There are no abrupt changes in topography to cause great differences in climate. The Great Lakes, lying to the north, have little effect on the Basin climate.

Factors which have a major influence in causing change in the climate are wind, cloudiness, and snowcover. The basin is located in the belt of prevailing westerly winds. Storm traces from western Canada and the Rockies move eastward by way of the Great Lakes and the Ohio Valley. In passing over large land masses the air becomes greatly chilled in winter and heated in summer, thus subjecting the Basin to temperature extremes. On clear days in winter, temperatures are often much lower than normal, while cloudy and rainy days are often well above normal. During summer, clear days often have temperatures well above normal and cloudy days have normal temperatures. In fall, temperatures on clear days are usually below normal, cloudy days are near normal, and rainy days have about normal temperatures. Snow cover prevents temperatures from rising during the day but allows additional cooling during the night.

Average annual temperature varies from 50°F in the northern counties to 54.5°F in the extreme southern part of the basin. Maximum temperatures recorded in the area range from 103°F to 107°F, and minimum temperatures ranged from -33°F in the highlands to -17°F in the low areas. Extreme maxima and minima temperatures from various gages throughout the Basin have been analysed by statistical methods. Figure 2-1 gives by months the

Figure 2-1
EXTREME LOW TEMPERATURE
WITH PROBABILITY EQUAL OR LESS THAN



Records of hourly and daily precipitation quantities have been and are continuing to be kept. These records enable statistical analyses of precipitation rates and amounts. Figure 2-3 gives by month, precipitation amounts that will occur on the average 5, 50, and 95 times in a 100 years. Figure 2-3 shows that approximately four inches of precipitation is expected 50 years in 100 (1 year in 2) during the months of June and July. Largest monthly precipitations occur during these months, although April and May have nearly as large amounts. Winter months receive less precipitation. Shaded areas on the bar graphs indicate degree of variations among the gages. Average annual precipitation in the Basin varies from 35 inches to 48 inches (Map 2-1).

In addition to precipitation by month and year, it is important to know the distribution of precipitation with time. Figure 2-4 gives rainfall intensely for storms which will occur on the average of 1, 10, and 50 times in 100 years. From the figure it is seen that the largest storm of 6 hour duration in an average 100 year period varies from 1.6 to 3.8 within the Basin.

The average length of growing season varies from 146 days in Wooster to 163 days in Zanesville. The first and last killing frosts occur in October and May respectively.

C. Physiography and Geology

The present Muskingum River Basin land surface differs markedly from that of the geological past. Rocks exposed in the Basin were deposited originally as sedimentary materials in warm shallow inland seas and coastal marshes. These thick sedimentary deposits later became consolidated bedrock after the seas receded. Slow uplift of these rock beds occurred at the end of Permian Time (235 million years ago) and were tilted slightly to the southeast with a regional dip of about 35 to 40 feet per mile. Subsequent erosion has removed all rocks younger than Permian Age exposing strata of Mississippian Age in the northwest part of the Basin. (Refer to Map 2-3). The youngest Permian beds are exposed mostly in Washington County in the southeast, while Pennsylvanian beds comprise most of the surface area within the Basin.

Figure 2-3

PRECIPITATION WITH PROBABILITY EQUAL OR LESS THAN

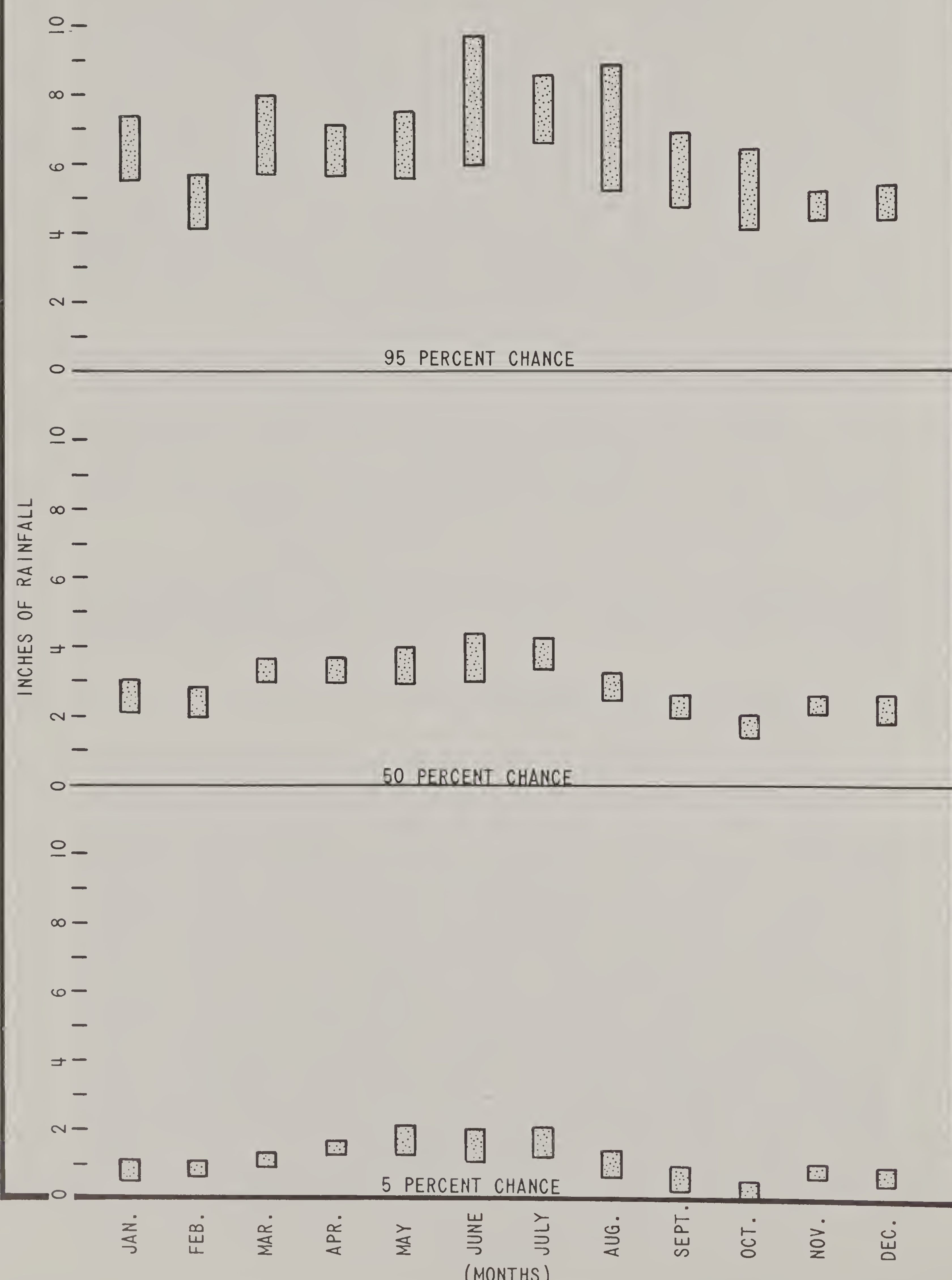
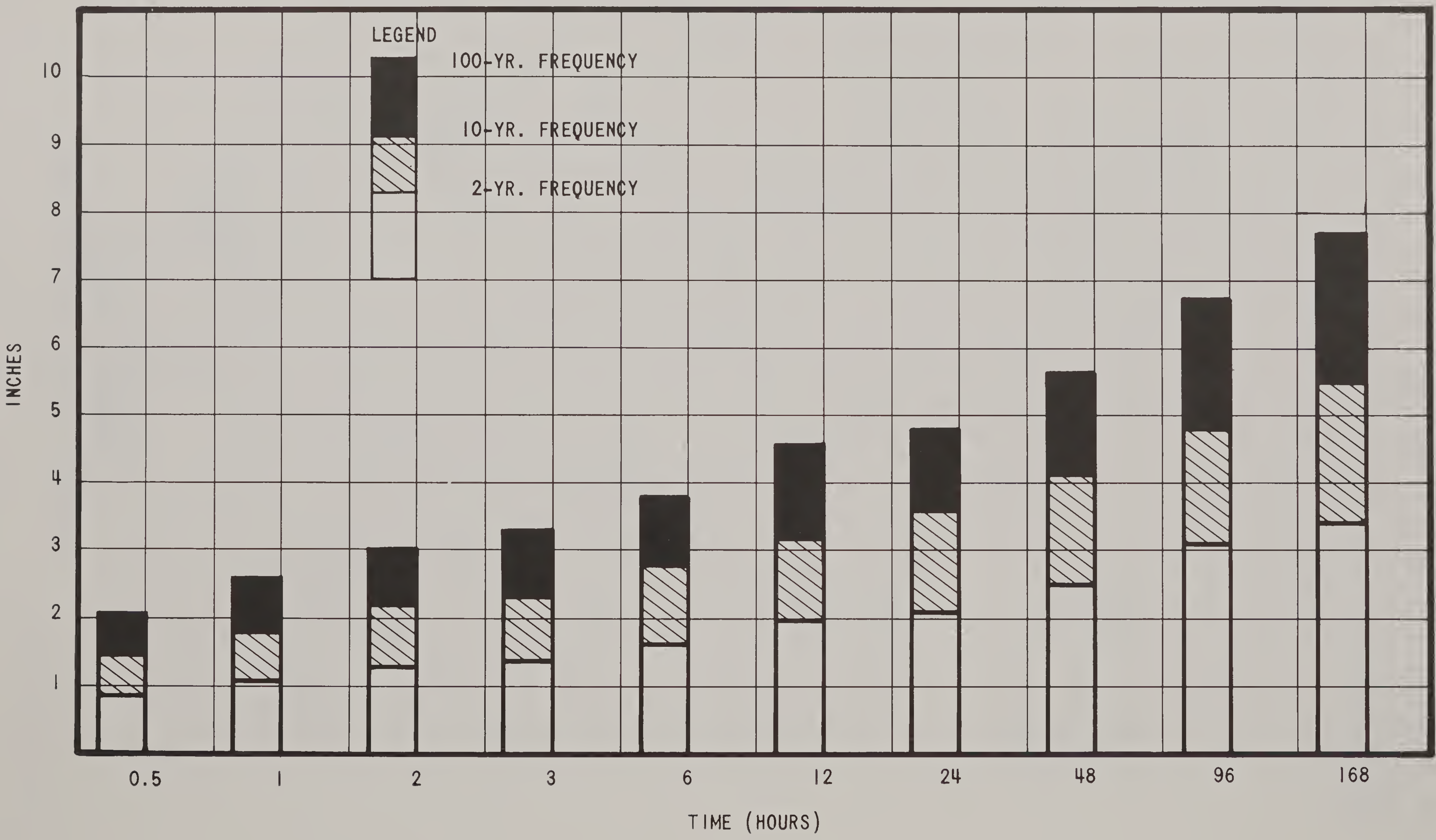
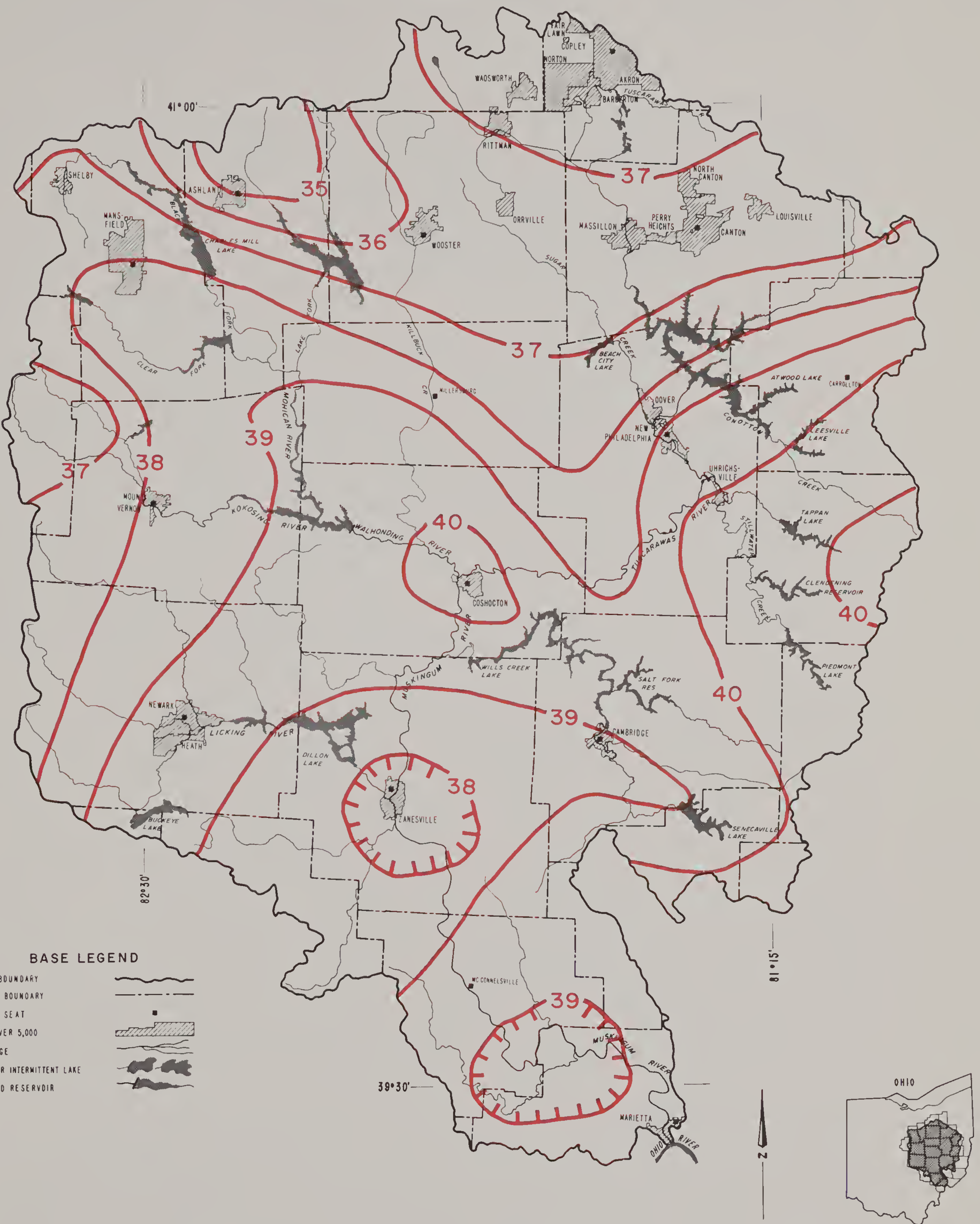


Figure 2-4
RAINFALL
VOLUME AND DURATION
AT COSHOCTON, OHIO



MAP 2-1

AVERAGE ANNUAL PRECIPITATION
IN INCHES 1931-1960
MUSKINGUM RIVER BASIN
OHIO



BASE LEGEND

BASIN BOUNDARY
COUNTY BOUNDARY
COUNTY SEAT
TOWN OVER 5,000
DRAINAGE
LAKE OR INTERMITTENT LAKE
DAM AND RESERVOIR

SCALE 1/1,065,000

SCALE 5 0 5 10 15 20 MILES

SOURCE:
FAMILY OF MAPS SCS DRAWING NO. 5,R-32,783 (1-30-74), U. S. WEATHER BUREAU DATA AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION.

7-12-74
5,N-34,352

USDA-SCS-LINCOLN, NEBR. 1974

Younger (and superimposed) deposits found in the Basin are sedimentary materials that have been transported in by continental glaciers, by streams, or by wind and water erosion.

Beneath the Mississippian rocks lie beds of progressively older geologic age, which are exposed only in the western part of Ohio and underly the surficial bedrock of the Muskingum River Basin: Devonian, Silurian, and Ordovician Systems. At greater depths are the ancient Cambrian and crystalline Pre-Cambrian Systems, none of which is exposed in Ohio.

Mississippian rocks of the Basin are mostly sandstones, conglomerates, and shales, with only one important limestone bed--the Maxville Limestone. Pennsylvanian rocks are similar to the Mississippian but with few conglomerates, more limestones, and the notable presence of coal. Coal has been mined from the Pottsville, Allegheny, and Monongahela Groups of the Pennsylvanian system but no important coal production has come from the Conemaugh Group. The Permian rocks also contain interbedded sandstones and shales with some coal seams, which are generally of poor quality.

No major geologic uplift or disturbance is known to have occurred from the close of Permian time (235 million years ago) to the beginning of the Pleistocene Epoch (1 million years ago). During the Pleistocene Epoch, three continental glaciers advanced across Ohio, two of which extended into the area of the Muskingum River Basin (See Maps 2-2 and 2-4). These are the Illinoian (200,000 years ago) and the Wisconsin (19,000 years ago). These glaciers deposited thick mantles of ice-borne sediments on the northern and western portions of the basin. The glaciated area is gently rolling with generally low topographic expression, whereas the unglaciated area is characterized by stream dissection and high relief.

The continental glaciers dammed and caused major changes in drainage patterns. The Teays River, which prehistorically flowed northwestwardly across southern Ohio, became blocked to the west, causing the major tributaries of the river to backflood into fingerlakes. Divides were breached, and drainage was diverted southward to what is now known as the Ohio River. During this

MAP 2-2

PHYSIOGRAPHIC SECTIONS
MUSKINGUM RIVER BASIN
OHIO

SOURCE:
FAMILY OF MAPS SCS DRAWING NUMBER 5,R-32,783 (1-30-74), STATE OF OHIO, DEPT. OF NATURAL RESOURCES, DIV. OF GEOLOGICAL SURVEY AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION.

USDA-SCS-LINCOLN, NEBR. 1974

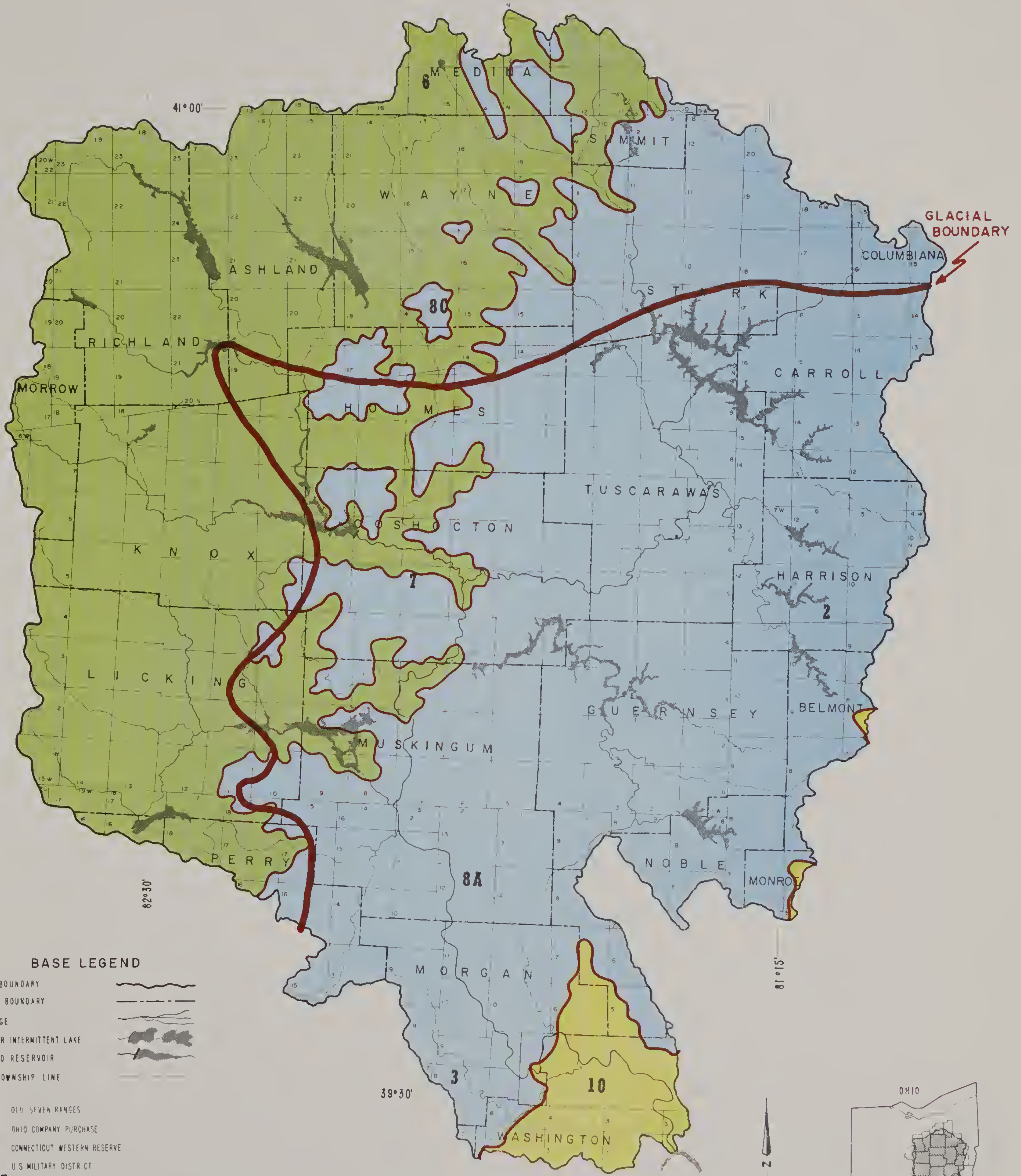
7-12-74
S,N-34,353

MAP 2-3

GEOLOGIC MAP

MUSKINGUM RIVER BASIN

OHIO



BASE LEGEND

- BASIN BOUNDARY
- COUNTY BOUNDARY
- DRAINAGE
- LAKE OR INTERMITTENT LAKE
- DAM AND RESERVOIR
- OLD TOWNSHIP LINE

2 OLD SEVEN RANGES
3 OHIO COMPANY PURCHASE
6 CONNECTICUT WESTERN RESERVE
7 U.S. MILITARY DISTRICT
8A CONGRESS LANDS EAST OF THE SCIOTO RIVER BY GREENVILLE TREATY
8C CONGRESS LANDS NORTH OF THE OLD SEVEN RANGES
10 DONATION TRACT

LEGEND

- PERMIAN
- PENNSYLVANIAN
- MISSISSIPPIAN

SCALE 1/1,065,000
SCALE 5 0 5 10 15 20 MILES

SOURCE:
FAMILY OF MAPS SCS DRAWING NO. 5,R-32,783 (1-30-74) OHIO DIVISION OF GEOLOGICAL SURVEY AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION.

7-12-74
5,N-34,354

USDA-SCS-LINCOLN, NEBR. 1974

U. S. DEPARTMENT OF AGRICULTURE

MAP 2-4

GLACIAL MAP

MUSKINGUM RIVER BASIN

OHIO

BASE LEGEND

- BASIN BOUNDARY
- COUNTY BOUNDARY
- DRAINAGE
- LAKE OR INTERMITTENT LAKE
- DAM AND RESERVOIR
- GLO TOWNSHIP LINE

2 OLD SEVEN RANGES
3 OHIO COMPANY PURCHASE
6 CONNECTICUT WESTERN RESERVE
7 U.S. MILITARY DISTRICT
8A CONGRESS LANDS EAST OF THE SCIOTO RIVER BY GREENVILLE TREATY
8C CONGRESS LANDS NORTH OF THE OLD SEVEN RANGES
10 DONATION TRACT

LEGEND

WISCONSIN	ILLINOIAN
KAMES AND ESKERS	UNDIFFERENTIATED
LAKE DEPOSITS	UNGLACIATED
GROUND MORAINE	
END MORAINE	

SCALE 1/1,065,000

SCALE 5 0 5 10 15 20 MILES

SOURCE:
FAMILY OF MAPS SCS DRAWING NO. 5,R-32,783 (1-30-74) STATE OF OHIO, DEPARTMENT OF NATURAL RESOURCES, DIV. OF GEOLOGICAL SURVEY, 1966, AND INFORMATION FROM FIELD TECHNICIANS.
TRANSVERSE MERCATOR PROJECTION.

7-12-74
5,N-34,355

USDA-SCS-LINCOLN, NEBR. 1974

time sands, silts, and outwash were deposited and filled ancient valleys. Included in the glacial till was scattered granite boulders which probably melted out from floating ice.

As the glaciers slowly melted, receded, and finally disappeared, they left behind great quantities of debris in the form of sand, gravel, clay, silt, and boulders. The present streams are now removing this filling of outwash material, but depositional remnants are still present as terraces found perched along some of the major streams such as the Muskingum, Walhonding, Licking, Mohican rivers and Killbuck Creek.

Bituminous coal is the most important mineral product mined within the area (See Map 2-5). Both the Pennsylvanian and Permian rocks contain coal beds, but the Allegheny and Monongahela Groups of the Pennsylvanian yield the bulk of the coal. This coal comes from the Middle Kittanning No. 6, Pittsburgh No. 8, and Meigs Creek No. 9 coal beds. Coal production has historically been greatest in Belmont, Coshocton, Harrison, Muskingum, Noble, and Tuscarawas counties, while surface mining (stripping) now produces a greater tonnage of coal than subsurface mining.

Oil and gas have long been produced from this area. Commercial drilling as early as 1860 has produced petroleum products from many strata ranging from the Silurian Clinton Formation (oldest) to the Pennsylvanian Conemaugh Group (youngest). Recent production has come from Muskingum, Guernsey, and Noble counties.

Clay shales have been quarried for pottery and refractory materials in Holmes, Muskingum, and Tuscarawas counties.

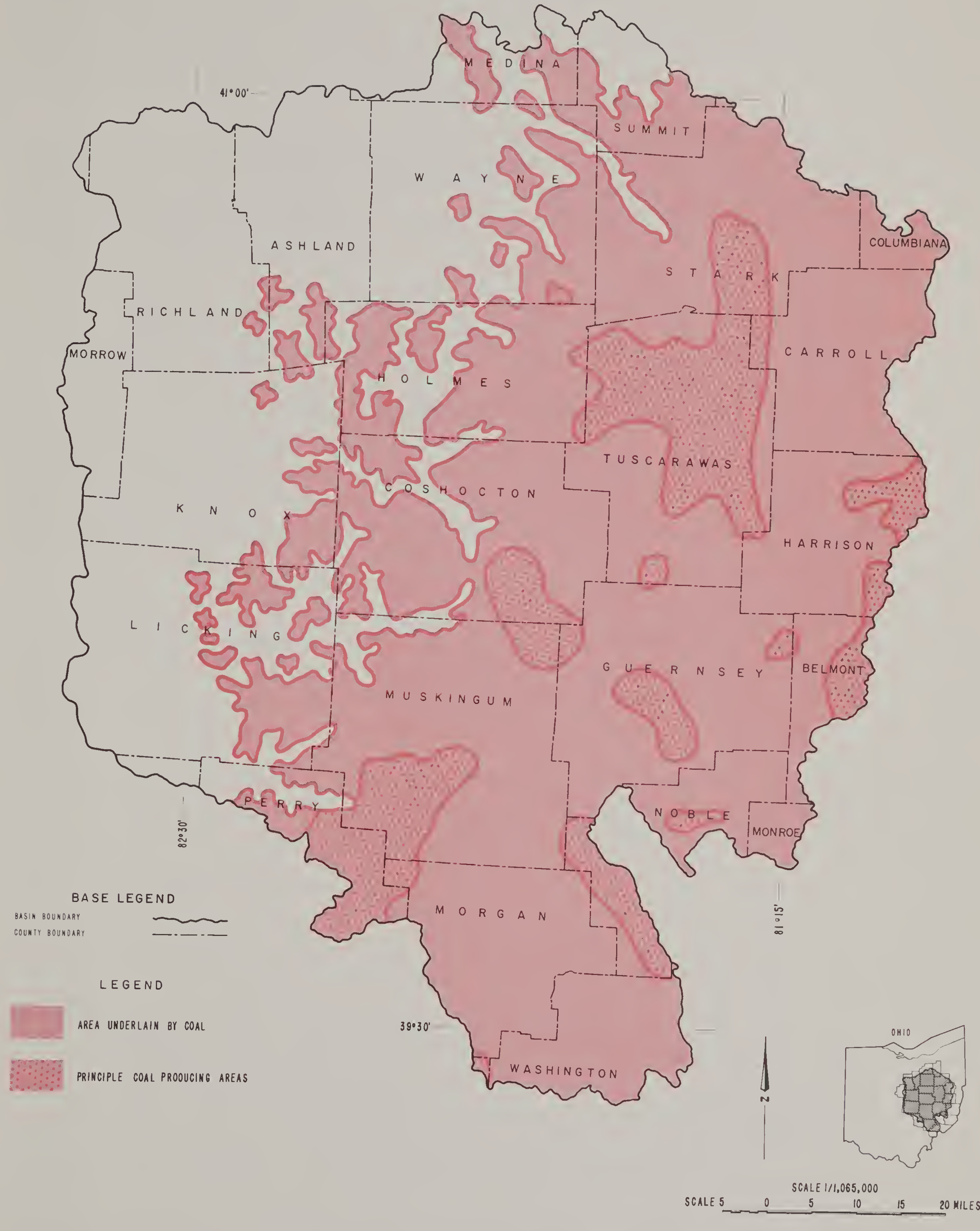
Limestone is mined in the Basin on a small scale as compared to production in western Ohio. The Maxville Limestone of Mississippian Age is quarried in Muskingum County for use as crushed stone, concrete aggregate, agricultural lime, and other uses. The Vanport Limestone of the Pennsylvanian Allegheny Group is quarried in Tuscarawas County for similar uses.

MAP 2-5

COAL PRODUCING AREAS

MUSKINGUM RIVER BASIN

OHIO



SOURCE:
FAMILY OF MAPS SCS DRAWING NO.
5,R-32,783 (1-30-74) AND INFORMATION
FROM FIELD TECHNICIANS. TRANSVERSE
MERCATOR PROJECTION.

USDA-SCS-LINCOLN, NEBR. 1974

7-12-74
5,N-34,356

Sandstone is quarried from the Massillon Formation of the Pennsylvanian Pottsville Group in Coshocton, Knox, and Tuscarawas counties for crushed stone, dimension stone, and refractory materials.

Sand and gravel are excavated from glacial deposits along the Muskingum and other rivers. The outwash deposits that fill the buried valleys are good sources of underground water supplies. (Refer to Ground Water Resource Map 2-8)

The study area has been divided into two portions by the continental ice sheet. The line of glaciation extends generally northward from a point about four miles southeast of Somerset in Perry County to near Loudonville in Ashland County. Thence the line extends eastward leaving the study area at Kensington on the Carroll-Columbiana county line. The glaciated area lies to the north and west of this line and is characterized by gently rolling topography. Toward the west variations in the land surface become less severe, gradually blending into the Central Lowlands. Nearly flat terrain is noted northwest of Shelby in Richland County. The unglaciated plateau to the south and east of this line is generally rough and well dissected, the only departure from this pattern being the broad valleys of the major streams.

Topographic relief in the Basin is about 920 feet. The highest point is about 1500 feet above mean sea level and the lowest point about 580 feet.

D. Land Resources

The Muskingum River Basin encompasses portions of four major land resource areas. Major Land Resource Area (MLRA) is a delineation of contiguous areas by the Soil Conservation Service which are similar in soil (including slope and erosion), climate, water resources, land use, and type of farming. MLRA boundary lines conform to delineations on general soil maps. Map 4-1 shows the delineations of the MLRA for the Basin. These MLRA are coded nationally as 124, 139, 126, and 111.

Approximately 45 percent of the Basin falls within MLRA 124 which is known as western Allegheny Plateau. About

three-fourths of the area is in farms. Hay and feed grains for livestock are the principal crops. Cropland occupies about one-fifth the area with pasture and tame grasses, and legumes covering another one-fifth. Two-fifths is in forest, about half of which is in farm woodlots. Strip mining of coal is important but only a small part of the area is in this use. The dissected sandstone plateau has narrow level valley floors, rolling ridgetops, and hilly to steep ridge slopes. Local relief is one to several hundred feet.

Eastern Ohio till plain, MLRA 139, covers 27 percent of the Basin. Approximately three-fourths of the area is in farms with urbanized areas occupying another one-fifth. Feed grains and forage for dairy cattle are the main crops. About one-third of the area is in cropland, one-fifth in hardwood forest which are mainly in farm woodlots, and one-tenth in pasture. The gently to strongly rolling dissected glaciated plateau is underlain by limestone and sandstone. Stream valleys are narrow and not deeply incised. Local relief ranges from a few feet to a hundred or more feet.

The southeast twenty percent of the Basin falls within the Central Allegheny Plateau, MLRA 126. Farms occupy ninety percent of the area. About one-sixth of the area is cropland and about one-fifth is in pasture. Hay and some grain for dairy cattle and other livestock are the major crops. Nearly half the area is in forest, and the sale of timber is an important source of income for many farm owners. The dissected plateau is underlain by sandstones and shales and some layers of calcareous rocks. Level narrow valleys and narrow rolling ridgetops are separated by long steep ridge slopes. Local relief is in hundreds of feet.

Indiana and Ohio Till Plain, MLRA 111, occupies eight percent of the western portion of the Basin. More than ninety percent of the area is in farms and about eighty percent in cropland. Corn, soybeans, other feed grains, and hay for livestock are the principal crops. Dairying is important near cities. Small areas of permanent pasture and small farm woodlots make up the remaining farm land. The surface area is gently sloping glacial-till which is broken in places by hilly moraines, kames, and outwash terraces. Relief varies from a few feet to as much as 100 feet.

The General Soils Map, Map 2-6, shows the distribution of soils within the Basin. Each soil association indicates the dominant soils for a geographic area. Table 2-4 gives a brief description of the soil limitations for specific land uses by soil association.

In terms of cropland harvested, hay, corn, wheat, and oats are the principal crops and accounted for slightly over 93 percent of the 1964 Basin cropland. Soybeans grown for beans brings the total to more than 97.5 percent. Hay crops were harvested from 619,000 acres in 1964, nearly 41 percent of the Basin's harvested cropland. Hay crops, nearly evenly divided between (1) alfalfa mixtures, and (2) clover-timothy mixtures, have increased their share of Basin cropland while wheat and oats have tended to decrease and corn has remained relatively stable.

Forest Land

The Muskingum River Basin falls in the Central Forest Region of Eastern North America. The most prevalent forest types in the northern, glaciated counties of the Basin are oak-hickory, and maple-beech on upland sites, and elm-ash-red maple on bottomland sites. These types account for 97 percent of the forest cover in the western and northern counties. In the remaining Basin counties, these three types plus a white pine-red pine type, comprise 90 percent of the forest and woodland. These type groups contain a great variety of individual tree species and shrubs. There are assorted hardwood (mainly ash, maple, and black locust) and softwood plantations (white pine, red pine, pitch pine, Virginia pine, and Norway spruce) established on idle or strip-mined land, especially in the eastern and southern portions of the Basin.

Major species throughout the Muskingum Basin are: red and white oaks, hickories, hard and soft maples, beech, ash, yellow poplar, black walnut, black cherry, elm, basswood, and aspen. Species of minor importance are sassafras, persimmon, black gum, sweet gum, buckeye, and ironwood.

Approximately 38,400 acres (1.8 percent) of the commercial forest land in the Muskingum River Economic Area

U. S. DEPARTMENT OF AGRICULTURE

LEGEND

BASIN BOUNDARY
COUNTY BOUNDARY
COUNTY SEAT
TOWN OVER 5,000
TOWN 1,000 - 5,000
DRAINAGE
LAKE OR INTERMITTENT LAKE
DAM AND RESERVOIR

SOIL ASSOCIATIONS

THE GENERALIZED SOIL MAP AND LEGEND FOR THE MUSKINGUM RIVER BASIN WAS COMPILED BY THE U.S. SOIL CONSERVATION SERVICE. SOURCES OF INFORMATION USED IN COMPILATION INCLUDED C.N.I. DATA, PUBLISHED SOIL SURVEYS, SOIL SURVEY MANUSCRIPTS, SCS SOIL HANDBOOKS, GENERAL SOIL MAPS OF COUNTIES PUBLISHED BY THE DIVISION OF LANDS AND SOIL O.D.N.R., AND COMMUNICATIONS WITH PROFESSIONAL SOIL SCIENTISTS WORKING IN THE AREA.

1 ELLSWORTH-MAHONING ASSOCIATION:
MODERATELY WELL AND SOMEWHAT POORLY DRAINED UPLAND SOILS THAT ARE DEEP. THESE SOILS ARE UNDERLAIN BY WISCONSIN AGE GLACIAL TILL CONTAINING A RELATIVELY LOW CONTENT OF CARBONATE MATERIALS. NEARLY LEVEL TO VERY STEEP.

2 RITTMAN-WADSWORTH-FRENCHTOWN ASSOCIATION:
MODERATELY WELL, SOMEWHAT POORLY AND POORLY DRAINED SOILS RESPECTIVELY. THESE DEEP UPLAND SOILS ARE UNDERLAIN BY WISCONSIN AGE GLACIAL TILL CONTAINING A RELATIVELY LOW CONTENT OF CARBONATE MATERIAL. LEVEL TO MODERATELY STEEP.

3 CHILI-WOOSTER ASSOCIATION:
THESE WELL-DRAINED SOILS OCCUR ON UPLANDS AND ALLUVIATED TERRACES. THE CHILI SOILS ARE UNDERLAIN BY STRATIFIED GRAVEL AND SAND MATERIAL AT A SHALLOW DEPTH. THE DEEP WOOSTER SOILS ARE UNDERLAIN BY WISCONSIN AGE GLACIAL TILL THAT IS NONCALCAREOUS OR ACID IN REACTION. LOCALLY, MANY SLOPES HAVE IRREGULAR SHAPES ASSOCIATED WITH KAME LAND FORMS. GENTLY SLOPING TO MODERATELY STEEP.

4 WOOSTER-CANFIELD ASSOCIATION:
WELL AND MODERATELY WELL DRAINED SOILS RESPECTIVELY. THESE DEEP UPLAND SOILS ARE UNDERLAIN BY WISCONSIN AGE GLACIAL TILL THAT IS COMMONLY ACID TO NONCALCAREOUS. GENTLY SLOPING TO MODERATELY STEEP.

5 RITTMAN-WADSWORTH ASSOCIATION:
MODERATELY WELL AND SOMEWHAT POORLY DRAINED UPLAND SOILS THAT ARE DEEP. THESE SOILS ARE UNDERLAIN BY WISCONSIN AGE GLACIAL TILL CONTAINING A RELATIVELY LOW CONTENT OF CARBONATES. MODERATELY STEEP TO NEARLY LEVEL.

6 LOUDONVILLE-MUSKINGUM-HANOVER ASSOCIATION:
WELL-DRAINED UPLAND SOILS. THE LOUDONVILLE AND MUSKINGUM SOILS ARE UNDERLAIN BY INTERBEDDED SILTSTONE AND SANDSTONE BEDROCK AT TWO TO FOUR FEET DEPTH. THE DEEP HANOVER SOILS ARE UNDERLAIN BY NONCALCAREOUS GLACIAL TILL OF ILLINOISAN AGE. SLOPING TO VERY STEEP.

7 CAROINGTON-BENNINGTON-MARENGO ASSOCIATION:
MODERATELY WELL, SOMEWHAT POORLY, AND VERY POORLY DRAINED SOILS RESPECTIVELY. THESE DEEP UPLAND SOILS ARE UNDERLAIN BY WISCONSIN AGE GLACIAL TILL HAVING A RELATIVELY LOW CONTENT OF CARBONATE MATERIAL. SLOPING TO NEARLY LEVEL.

8 HANOVER-MUSKINGUM ASSOCIATION:
DEEP AND MODERATELY DEEP UPLAND SOILS THAT ARE WELL-DRAINED. THE HANOVER SOILS ARE UNDERLAIN BY ILLINOISAN TILL AND THE MUSKINGUM SOILS ARE UNDERLAIN BY SILTSTONE AND SANDSTONE BEDROCK AT TWO TO FOUR FEET DEPTH. GENTLY SLOPING TO STEEP.

9 BERKS-MUSKINGUM ASSOCIATION:
WELL-DRAINED SHALLOW AND MODERATELY DEEP UPLAND SOILS. THESE RESIDUAL SOILS ARE UNDERLAIN BY SILTSTONE, SANDSTONE, AND SHALE. SLOPING TO VERY STEEP.

10 GILPIN-KEENE ASSOCIATION:
WELL-DRAINED MODERATELY DEEP TO DEEP UPLAND SOILS. THESE RESIDUAL SOILS ARE UNDERLAIN BY SILTSTONE AND SHALE INCLUDING A RELATIVELY SMALL AMOUNT OF SANDSTONE. SLOPING TO VERY STEEP.

11 GILPIN-DeKALB ASSOCIATION:
WELL-DRAINED MODERATELY DEEP AND SHALLOW UPLAND SOILS. THESE RESIDUAL SOILS ARE UNDERLAIN BY SILTSTONE AND SANDSTONE. SLOPING TO VERY STEEP.

12 GILPIN-ZANESVILLE ASSOCIATION:
WELL-DRAINED MODERATELY DEEP AND DEEP UPLAND SOILS. THESE RESIDUAL SOILS ARE UNDERLAIN BY BEDROCK MATERIAL THAT INCLUDES SILTSTONE, SANDSTONE, AND SHALE. SLOPING TO VERY STEEP.

13 WESTMORELAND-GILPIN ASSOCIATION:
WELL-DRAINED MODERATELY DEEP UPLAND SOILS. THESE RESIDUAL SOILS ARE UNDERLAIN BY VARYING PROPORTIONS OF CALCAREOUS AND NONCALCAREOUS SHALES, INTERBEDDED WITH SILTSTONE, SANDSTONE, AND SMALL BUT SIGNIFICANT AMOUNTS OF DOLOMITIC LIMESTONE. SLOPING TO VERY STEEP.

14 WESTMORELAND-WESTMORE ASSOCIATION:
WELL-DRAINED MODERATELY DEEP UPLAND SOILS. THESE RESIDUAL SOILS ARE UNDERLAIN BY CALCAREOUS SHALES CONTAINING SOME SHALES THAT ARE NONCALCAREOUS. SMALL BUT SIGNIFICANT AMOUNTS OF DOLOMITIC LIMESTONE OCCURS LOCALLY. SLOPING TO VERY STEEP.

15 GILPIN-LATHAM ASSOCIATION:
MODERATELY DEEP WELL-DRAINED UPLAND SOILS. THESE RESIDUAL SOILS ARE UNDERLAIN BY SILTSTONE AND SHALE, AND WITH SANDSTONE ON LOCAL VERY STEEP AREAS. SLOPING TO VERY STEEP.

16 GILPIN-GUERNSEY ASSOCIATION:
WELL-DRAINED MODERATELY DEEP UPLAND SOILS. THESE RESIDUAL SOILS ARE UNDERLAIN BY INTERBEDDED SILTSTONE, GRAY SHALE, AND SANDSTONE WITH LOCAL AREAS OF RED CLAY SHALE AND CALCAREOUS SHALE. STEEP TO VERY STEEP.

17 GILPIN-UPSHUR-VANDALIA ASSOCIATION:
WELL-DRAINED MODERATELY DEEP AND DEEP RESIDUAL UPLAND SOILS INTERSPERSED WITH RIDGETOPS OCCUPIED BY REMNANTS OF OLD TERRACE MATERIALS. THESE SOILS ARE UNDERLAIN BY SILTSTONE, RED AND GRAY SHALES, AND SANDSTONE MATERIALS. DEEP MONONGAHELA AND VINCENT SOILS OCCUPY THE OLD TERRACE REMNANTS UNDERLAIN BY HIGHLY WEATHERED SILTY, CLAYEY, AND SANDY MATERIALS. MODERATELY STEEP AND VERY STEEP SLOPES.

18 GILPIN-UPSHUR ASSOCIATION:
WELL-DRAINED MODERATELY DEEP UPLAND SOILS. THESE RESIDUAL SOILS ARE UNDERLAIN BY SILTSTONE, RED SHALE, AND GRAY SHALE. SLOPING TO VERY STEEP.

AD HOC SYMBOLS
THE FOLLOWING AD HOC SYMBOLS REPRESENT RELATIVELY NARROW STREAM VALLEY AREAS HAVING IRREGULAR LINEAL SHAPES THAT ARE TOO SMALL TO SHOW AS INDIVIDUAL DELINEATIONS ON THIS GENERAL SOIL MAP SCALE. THESE AREAS ARE SOIL ASSOCIATIONS ADJACENT TO MOST OF THE PRINCIPAL STREAMS. EACH SYMBOL REPRESENTS ABOUT 10,000 ACRES AND ARE ALLOCATED ON A COUNTY BASIS DERIVED FROM C.N.I. DATA.

+ ORRVILLE-CHAGRIN-CHILI ASSOCIATION:
THE SOMEWHAT POORLY DRAINED ORRVILLE AND WELL-DRAINED CHAGRIN SOILS OCCUPY FLOOD PLAINS AND ARE UNDERLAIN BY SILTY ALLUVIAL MATERIAL. THE WELL-DRAINED DROUGHTY CHILI SOILS ARE ON ALLUVIATED TERRACES AND UNDERLAIN BY STRATIFIED GRAVELLY AND SANDY MATERIAL. LEVEL TO GENTLY SLOPING.

○ HUNTINGTON-WHEELING-CHILI ASSOCIATION:
THE WELL-DRAINED HUNTINGTON SOILS OCCUPY THE FLOOD PLAINS AND ARE UNDERLAIN BY SILTY ALLUVIAL MATERIAL. THE WELL-DRAINED WHEELING AND WELL-DRAINED DROUGHTY CHILI SOILS OCCUPY ALLUVIATED TERRACES THAT ARE UNDERLAIN BY STRATIFIED GRAVELLY AND SANDY MATERIAL. LEVEL TO GENTLY SLOPING.

⊙ MONONGAHELA-STENDAL ASSOCIATION:
MODERATELY WELL AND SOMEWHAT POORLY DRAINED SOILS RESPECTIVELY. THE MONONGAHELA SOILS OCCUPY ALLUVIATED TERRACES AND ARE UNDERLAIN BY SILTY MATERIAL. THE STENDAL SOILS OCCUPY FLOOD PLAINS AND ARE UNDERLAIN BY SILTY ALLUVIAL MATERIAL. LEVEL TO SLOPING.

GENERAL SOIL MAP

MUSKINGUM RIVER BASIN

OHIO

MAP 2-6

SOURCE: FAMILY OF MAPS SCS DRAWING NO. 5,R-32,783 (1-30-74) AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION.

USDA SCS LINCOLN, NEBR 1974

9-12-74
5,P-34,357

Table 2-4

Degree of Soil Limitation for Specific Land Uses, Muskingum River Basin, Ohio

Soil Association	Soil Series	Estimated Degree and Kind of Limitation of Soils for Specific Land Uses				
		Percent	Septic Tank Filter Field	Parks, Play and Picnic Areas	Campsites	Sanitary Land Fill
1	Ellsworth	65	Severe: 10	Slight	Severe: 10	Moderate: 3
	Mahoning	30	Severe: 10, 11	Moderate: 11	Severe: 10, 11	Moderate: 3
	Other	5				
2	Rittman	55	Severe: 10	Slight	Severe: 10	Moderate: 3, 6
	Wadsworth	35	Severe: 10, 11	Moderate: 11	Severe: 10, 11	Severe: 11
	Frenchtown	5	Severe: 10	Severe: 7	Severe: 7, 10	Severe: 7
	Other	5				
3	Chili	55	Moderate: 9 1/	Moderate: 9	Moderate: 9	Severe: 8 1/
	Wooster	15	Moderate: 4, 9	Moderate: 9	Moderate: 9	Moderate: 9
	Other	30				
4	Wooster	50	Moderate: 4, 9	Moderate: 9	Moderate: 9	Moderate: 9
	Canfield	30	Moderate: 6	Slight	Moderate: 5, 6	Moderate: 6
	Other	20				
5	Rittman	85	Severe: 10	Moderate: 9	Severe: 10	Moderate: 3, 6
	Wadsworth	15	Severe: 10, 11	Moderate: 11	Severe: 10, 11	Severe: 11
6	Loudonville	45	Severe: 2, 9	Severe: 9	Severe: 9	Severe: 2, 9
	Muskingum	30	Severe: 2, 9	Severe: 9	Severe: 9	Severe: 2, 9
	Hanover	15	Moderate: 9	Moderate: 9	Moderate: 9	Moderate: 9
	Other	10				
7	Cardington	45	Severe: 9, 10	Moderate: 9	Moderate: 5, 9	Moderate: 1, 5
	Bennington	30	Severe: 10, 11	Moderate: 11	Moderate: 10, 11	Moderate: 11
	Marengo	15	Severe: 5, 13	Severe: 13	Severe: 13	Severe: 13, 1
	Other	10				

Table 2-4 cont'd.

Soil Association	Soil Series	Percent	Septic Tank Filter Field	Parks, Play and Picnic Areas	Campsites	Sanitary Land Fill
		Estimated Degree and Kind of Limitation of Soils for Specific Land Uses				
8	Hanover	55	Moderate: 9	Moderate: 9	Moderate: 9	Moderate: 9
	Muskingum	20	Severe: 2, 9	Severe: 9	Severe: 9	Severe: 2, 9
	Other	25				
9	Berks	50	Severe: 2, 9	Severe: 2, 9	Severe: 2, 9	Severe: 2, 9
	Muskingum	40	Severe: 2, 9	Severe: 9	Severe: 9	Severe: 2, 9
	Other	10				
10	Gilpin	50	Severe: 2, 9	Severe: 9	Severe: 9	Severe: 2, 9
	Keene	20	Severe: 10	Moderate: 9	Severe: 10	Moderate: 2, 1
	Other	30				
11	Gilpin	70	Severe: 2, 9	Severe: 9	Severe: 9	Severe: 2, 9
	DeKalb	15	Severe: 2	Moderate 2, 9	Moderate: 9	Severe: 2
	Other	15				
12	Gilpin	55	Severe: 2, 9	Severe: 9	Severe: 9	Severe: 2, 9
	Zanesville	45	Severe: 9	Severe: 9	Severe: 9	Severe: 9
13	Westmoreland	40	Severe: 9	Severe: 9	Severe: 9	Severe: 2
	Gilpin	25	Severe: 2, 9	Severe: 9	Severe: 9	Severe: 2, 9
	Other	35				
14	Westmoreland	40	Severe: 9	Severe: 9	Severe: 9	Severe: 2
	Westmore	25	Severe: 10	Moderate: 9	Severe: 10	Moderate: 9
	Other	35				
15	Gilpin	45	Severe: 2, 9	Severe: 9	Severe: 9	Severe: 2, 9
	Latham	25	Severe: 10, 9	Severe: 9	Severe: 10, 9	Severe: 9
	Other	30				

Table 2-4 cont'd.

Soil Association	Soil Series	Percent	Septic Tank Filter Field	Parks, Play and Picnic Areas	Campsites	Sanitary Land Fill
		Estimated Degree and Kind of Limitation of Soils for Specific Land Uses				
16	Gilpin	30	Severe: 2, 9	Severe: 9	Severe: 9	Severe: 2, 9
	Guernsey	30	Severe: 9, 10	Severe: 9	Severe: 9, 10	Severe: 1, 9
	Other	40				
17	Gilpin	25	Severe: 2, 9	Severe: 9	Severe: 9	Severe: 2, 9
	Upshur	20	Severe: 9, 10	Severe: 9	Severe: 9	Severe: 1, 9
	Vandalia	15	Severe: 9, 10	Severe: 1, 9	Severe: 9, 10	Severe: 1, 9
	Other	40				
18	Gilpin	45	Severe: 2, 9	Severe: 9	Severe: 9	Severe: 2, 9
	Upshur	35	Severe: 9, 10	Severe: 9	Severe: 9	Severe: 1, 9
	Other	20				
†	Orrville	25	Severe: 12, 7 1/	Severe: 12, 7	Severe: 12, 7	Severe: 12, 7 1/
	Chagrin	20	Severe: 12 1/	Moderate: 12	Moderate: 12	Severe: 12 1/
	Chili	20	Slight 1/	Slight	Slight	Severe: 8 1/
	Other	35				
0	Huntington	25	Severe: 12 1/	Severe: 12	Severe: 12	Severe: 12 1/
	Wheeling	25	Slight 1/	Slight	Slight	Severe: 8 1/
	Chili	20	Slight 1/	Slight	Slight	Severe: 8 1/
	Other	30				
⊙	Monongahela	25	Severe: 9, 10	Severe: 9, 10	Moderate: 9, 10	Moderate: 9
	Stendall	20	Severe: 11, 12 1/	Severe: 11, 12	Severe: 11, 12	Severe: 11, 12 1/
	Other	55				

1/ Pollution hazards to nearby streams, lakes, springs, or underground water supply is very likely because of inadequate filtration of soil materials common to these soils.

Table 2-4 cont'd.

CODE:

1. Clayey subsoil
2. Limited depth to bedrock
3. Moderately fine textured
4. Moderately permeable
5. Moderately slow permeability
6. Moderately well drained
7. Poorly drained
8. Pervious substrata
9. Slope
10. Slowly permeable
11. Somewhat poorly drained
12. Subject to flooding
13. Very poorly drained

(MREA) are federally owned. Of this, 38,000 acres are in in the Wayne National Forest, and administered by the U.S. Department of Agriculture - Forest Service under the Multiple Use and Sustained Yield Act of 1960. However, only 200-300 acres of the 38,000 fall within the hydrologic boundaries of the Muskingum River Basin. The remaining 400 acres are under the administration of other government agencies, and management varies according to use priority. State Forest ownership amounts to 8,700 acres (0.5 percent), and the remaining 2,044,820 acres of commercial forest land in the MREA are in private ownership, including industry or utility-owned land.

Approximately 100 percent of the public owned forest land is under management while only 52 percent of private forest holdings are managed.

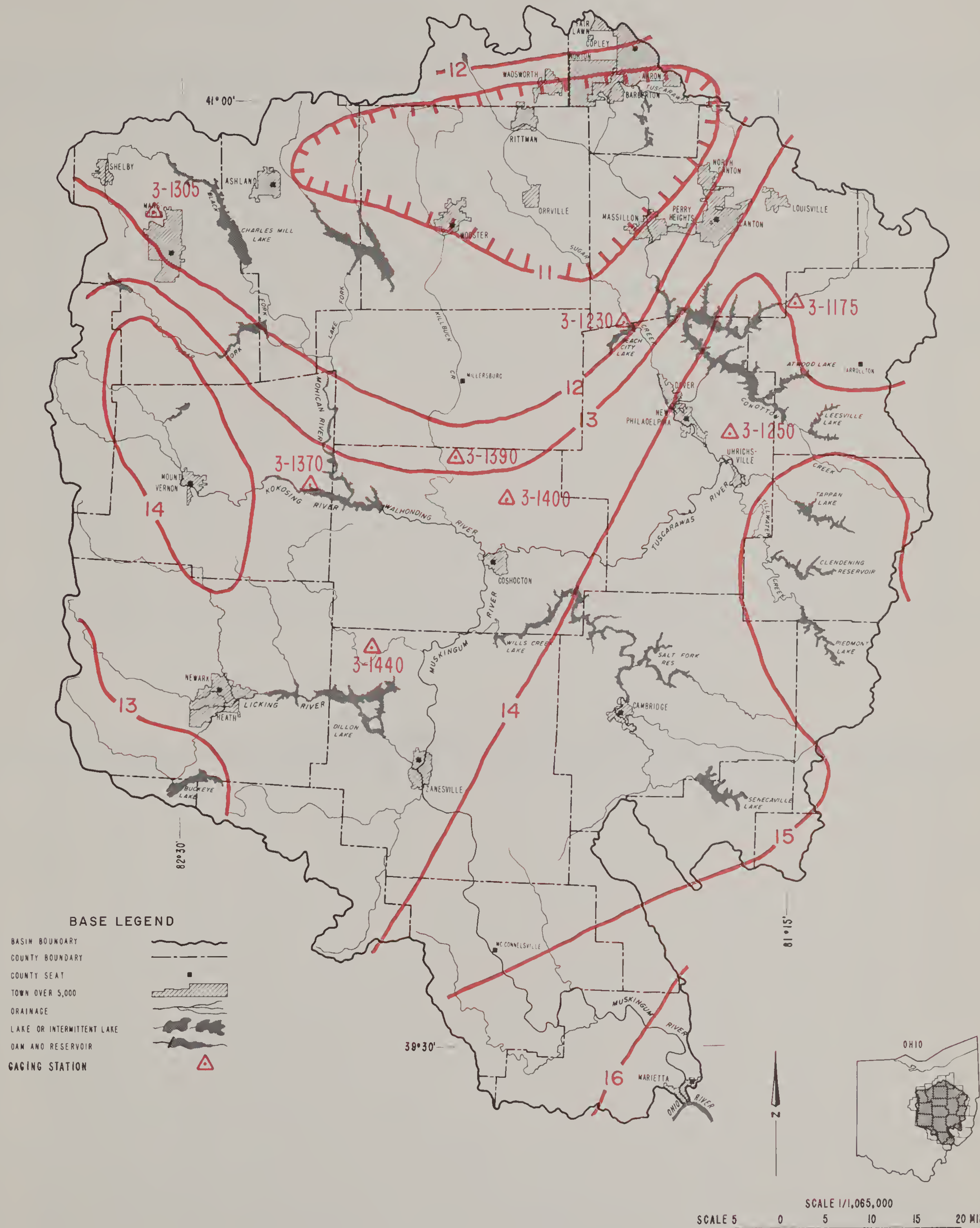
E. Water Resources

Approximately 40 inches of rainfall falls over the Basin per year. Much of the part which infiltrates into the soil is available for a consumptive use. Most of it remains near the surface and is either evaporated or transpired through plants. A portion of the water passes on through the root zone. Part of this water recharges into aquifiers and is pumped from wells for use. Some water resurfaces in the form of seeps or springs. Opportunity has been taken to develop some of these seeps and springs for livestock water, trout ponds, and other uses. Water not consumed flows on through the watershed where it is available as stream flow resource.

Average annual stream flow varies from 12 inches in the northern part of the basin to 16 inches in the south (Map 2-7). The four month interval, January through April, has approximately 60 percent of the total average annual stream flow. The highest monthly stream flow occurrs in March (Fig. 2-5). September has the lowest average monthly stream flow. Figure 2-5 shows monthly high flow distribution for several gages. Floods have occurred in September and low flows have occurred in March. Monthly variations of surface runoff are quite pronounced. Of the 1800 billion gallons of total stream flow in the Basin the greater portion occurs during high

MAP 2-7

AVERAGE ANNUAL STREAMFLOW IN INCHES 1931-1960 MUSKINGUM RIVER BASIN OHIO



SOURCE:
FAMILY OF MAPS SCS DRAWING NO. S,R-32,783 (1-30-74) U. S. GEOLOGICAL SURVEY, AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION.

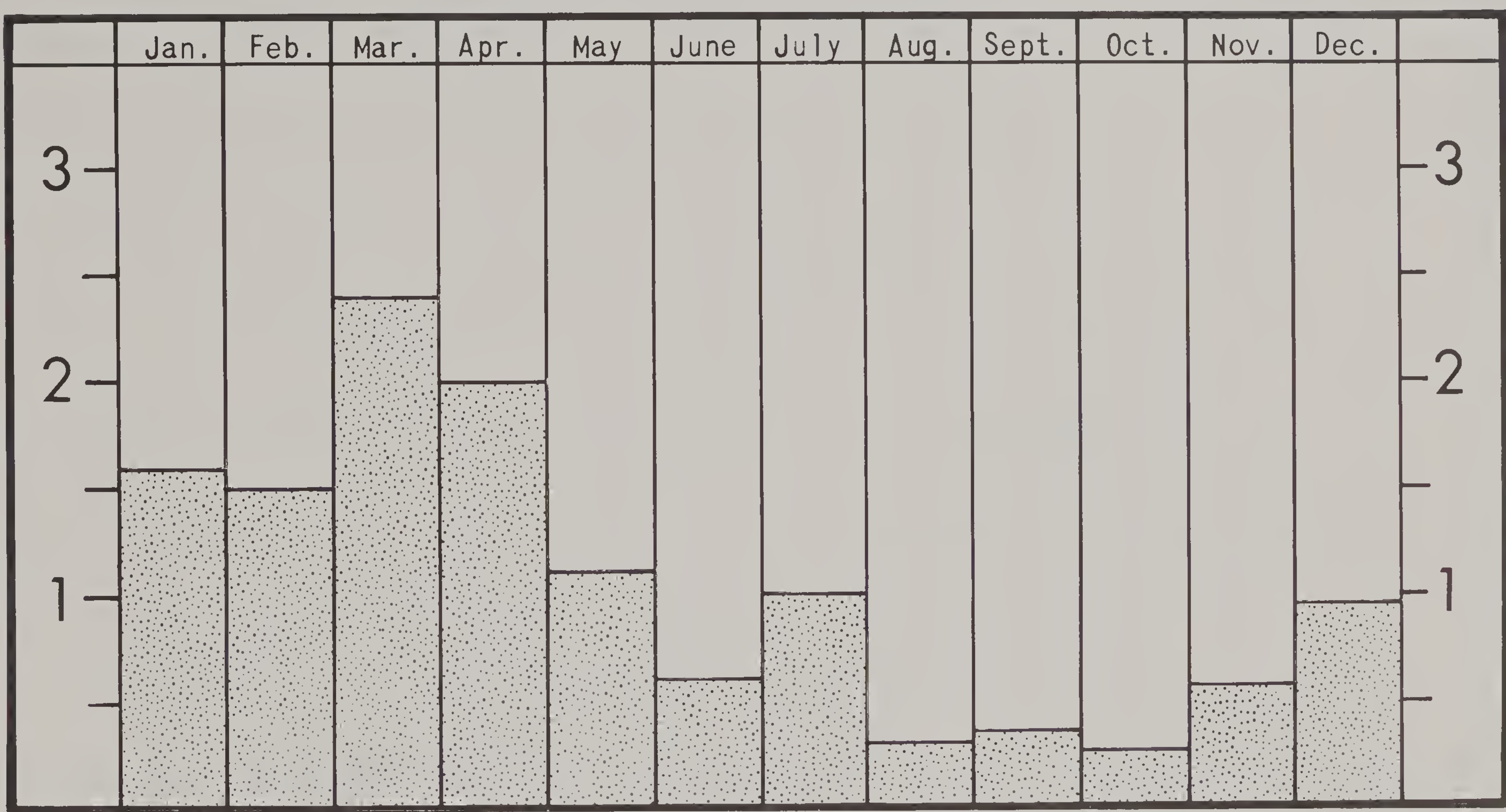
7-12-74
S,N-34,358

USDA-SCS-LINCOLN, NEBR. 1974

Figure 2-5

Gage No. 3-1305 D. Area 5.44 Sq.mi.

AVERAGE MONTHLY RUNOFF IN INCHES



Gage No. 3-1370 D. Area 455.0 Sq.mi.

AVERAGE MONTHLY RUNOFF IN INCHES

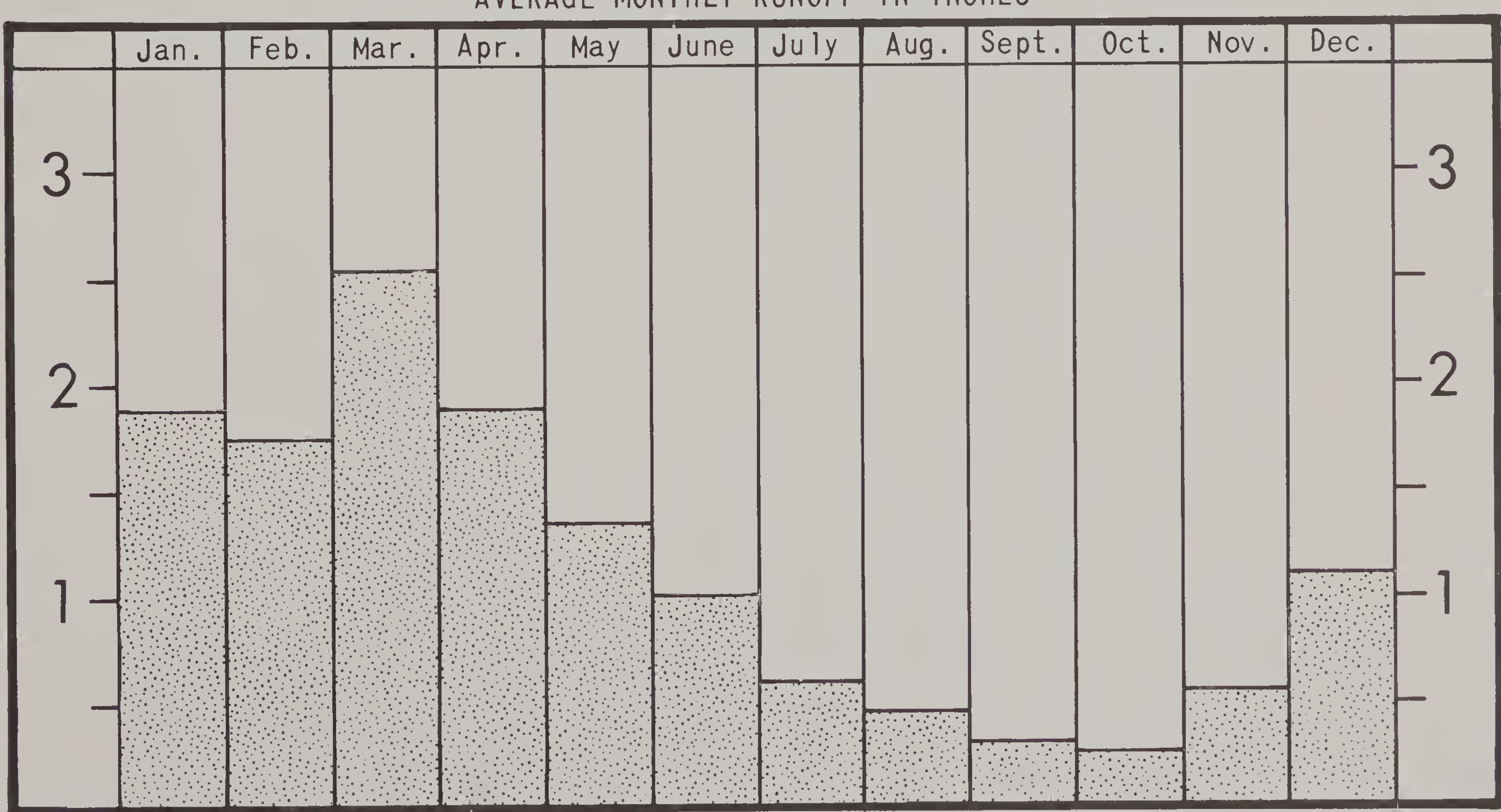
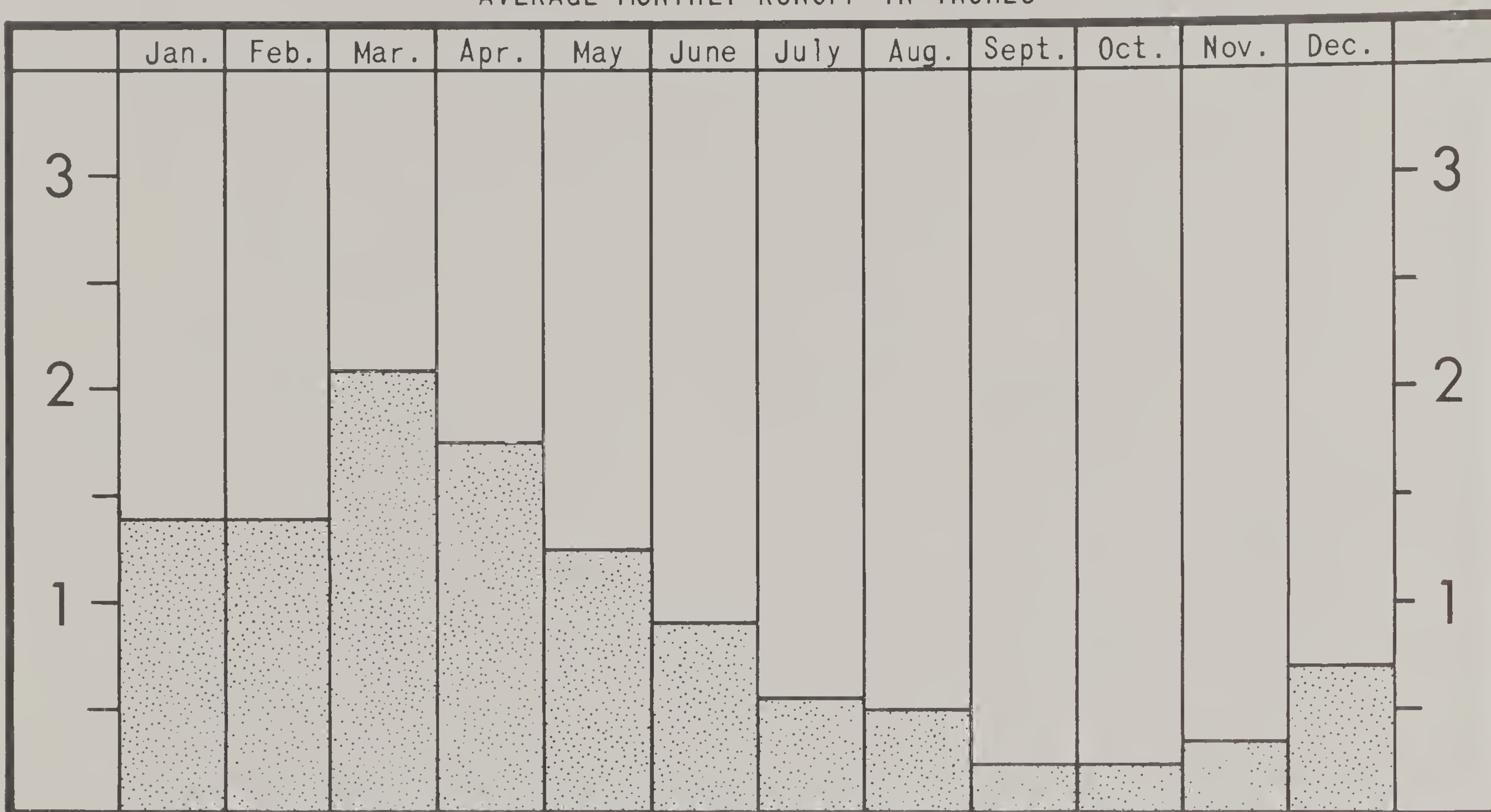


Figure 2-5

Gage No. 3-1390 D. Area 462.0 Sq.mi.

AVERAGE MONTHLY RUNOFF IN INCHES



Gage No. 3-1175 D. Area 253.0 Sq.mi.

AVERAGE MONTHLY RUNOFF IN INCHES

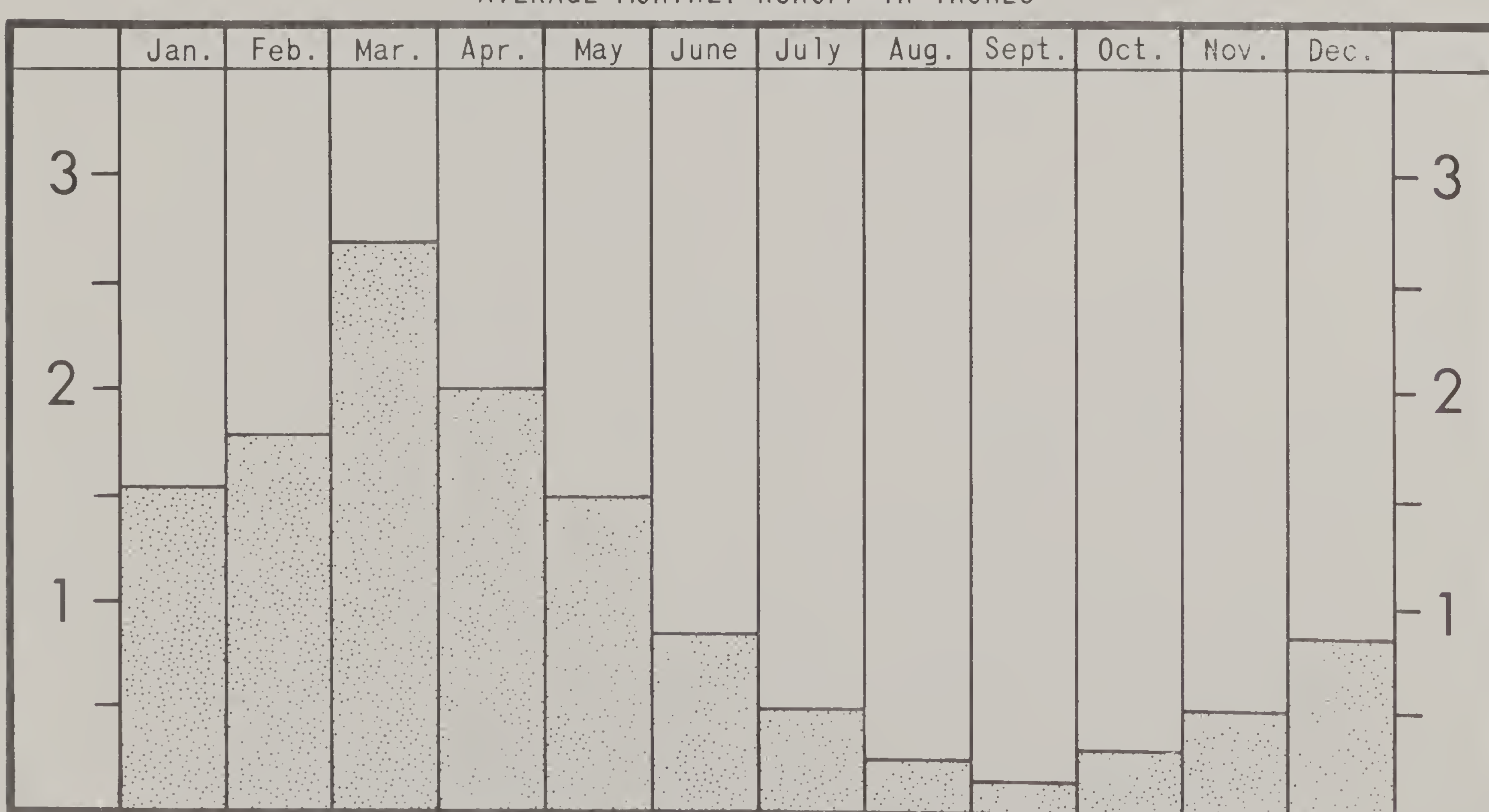
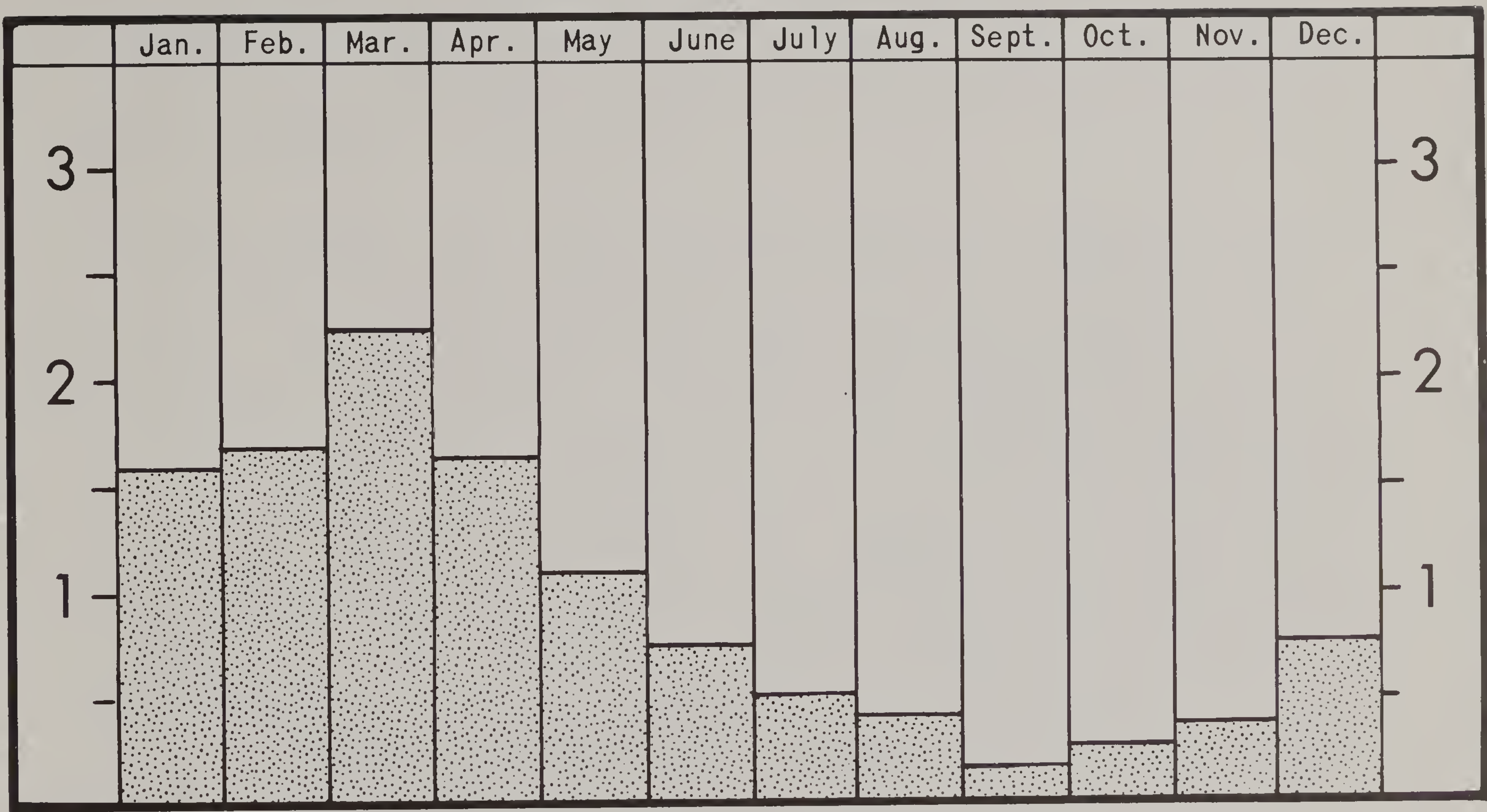


Figure 2-5

Gage No. 3-1230 D. Area 160.0 Sq.mi.

AVERAGE MONTHLY RUNOFF IN INCHES



Gage No. 3-1250 D. Area 1.64 Sq.mi.

AVERAGE MONTHLY RUNOFF IN INCHES

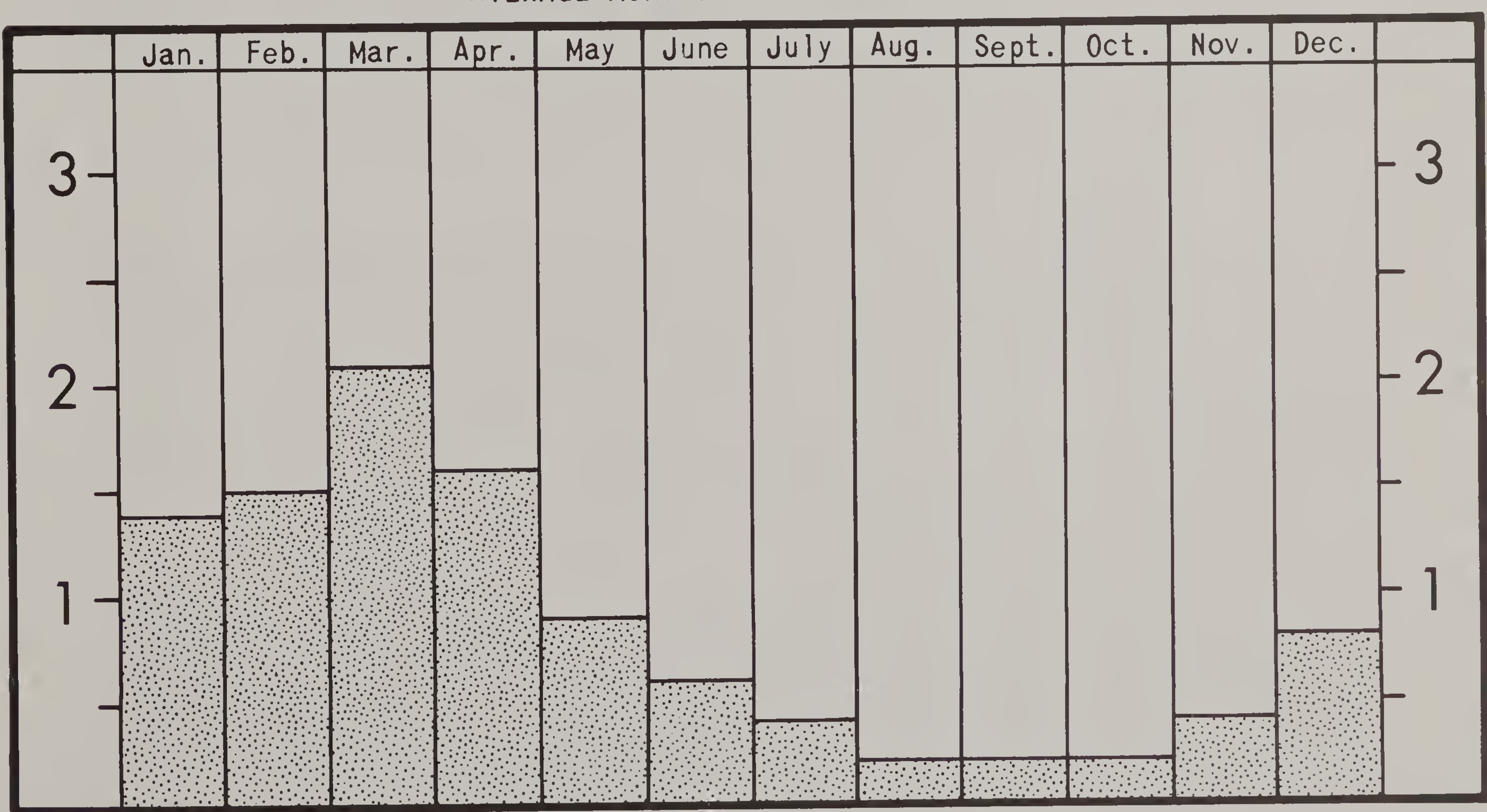
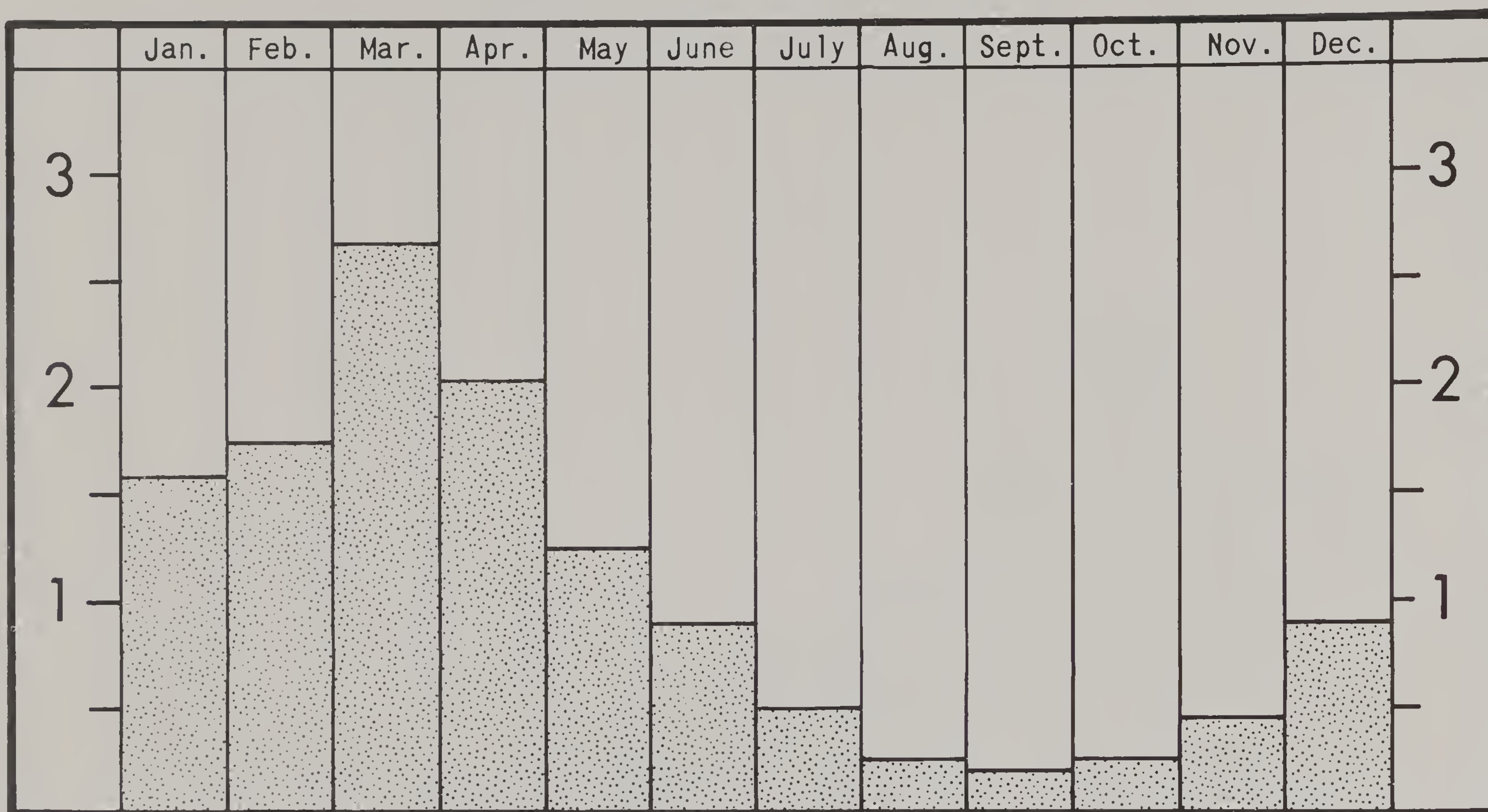


Figure 2-5

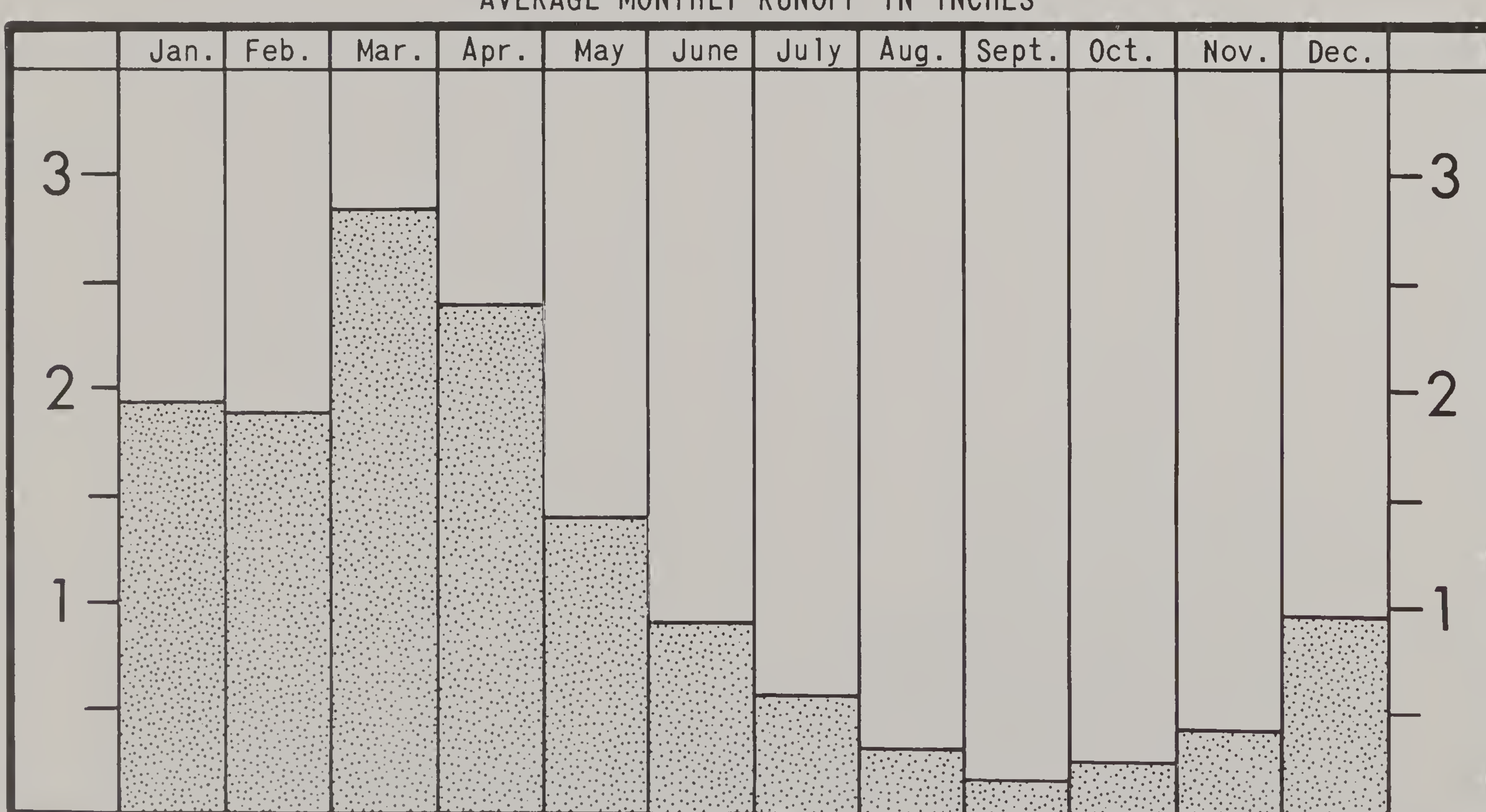
Gage No. 3-1400 D. Area 27.2 Sq.mi.

AVERAGE ANNUAL RUNOFF IN INCHES



Gage No. 3-1440 D. Area 140.0 Sq.mi.

AVERAGE MONTHLY RUNOFF IN INCHES



flows and is passed through the watershed without providing the opportunity for beneficial use. Often the large flows cause flooding which has a negative effect on the Basin economy. This wasted water resource can be managed to provide more water during periods of natural low flows. Stream flow is a vast resource and much remains to be done in the Basin to efficiently utilize the resource.

Water yields of more than 1000 gpm per well have been drilled. Greatest yields occur from buried gravel valleys traversed by principle surface streams (Map 2-8). Nearly two-thirds of the total municipal water use is obtained from wells. Studies show a big potential for expanded use and management of the ground water. Sites exist where the combination of subsurface materials provide extensive storage, good permeability, and rapid recharge. These big aquifers are localized and not found in large areas of the Basin. Many small towns and rural residences are located in areas where the geologic profiles show poor potential for developing large ground water yields. The northwestern two-thirds of the Basin is underlaid by alternating shales and sandstones with ground water yields ranging from 5 to 15 gpm. Where thick, porous sandstones are present, yields of 25 gpm or more are obtained. Rocks in the southeastern third of the area include alternating layers of sandstone, shale, limestone, fireclay, and coal. Generally, shales and few thin sandstones predominate. Wells drilled in these rocks rarely yield more than 5 gpm, and often go dry thus necessitating the use of dug wells and cisterns.

The Muskingum River Basin has a few natural lakes, all of which are located in the northern fourth of the Basin. Numerous reservoir sites, have been developed to store water for various uses. There are 740 bodies of water with surface areas in excess of two acres. The total water surface area is about 33,900 acres. Sixteen of these reservoirs provide community water supplies.

The most important water resource is rainfall. This is essential to those persons within the basin whose occupations involve the production of agricultural or forest products. Approximately 99.8 percent of the

BASE LEGEND

- BASIN BOUNDARY
- COUNTY BOUNDARY
- COUNTY SEAT
- TOWN OVER 5,000
- TOWN 1,000 - 5,000
- DRAINAGE
- LAKE OR INTERMITTENT LAKE
- DAM AND RESERVOIR

LEGEND

- AREAS IN WHICH YIELDS OF 100 TO 1000 GALLONS PER MINUTE OR MORE CAN BE DEVELOPED.
- AREAS IN WHICH YIELDS OF 25 TO 100 GALLONS PER MINUTE CAN BE DEVELOPED.
- AREAS IN WHICH YIELDS OF 5 TO 25 GALLONS PER MINUTE CAN BE DEVELOPED.
- AREAS IN WHICH YIELDS OF LESS THAN 5 GALLONS PER MINUTE CAN BE DEVELOPED.

GROUND WATER RESOURCES

MUSKINGUM RIVER BASIN

OHIO

MAP 2-8

SOURCE: FAMILY OF MAPS SCS DRAWING NO. 5,R-34,783 (1-30-74) AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION

9-12-74
5,P-34,359

USDA SCS LINCOLN NEBR 1974

cropland is farmed without supplemental moisture. Rainfall is adequate to provide the necessary moisture to yield good economic returns on the committed inputs of labor and capital. Effort to utilize the available rainfall more efficiently is apparent throughout the Basin. Conservation practices such as contour farming, strip cropping, and rotation cropping have been applied. These increase infiltration. On some agricultural lands the problem is too much water. These areas are improved by implementing drainage practices.

F. <u>Fish and Wildlife Resources</u>

Game and Commercial Species

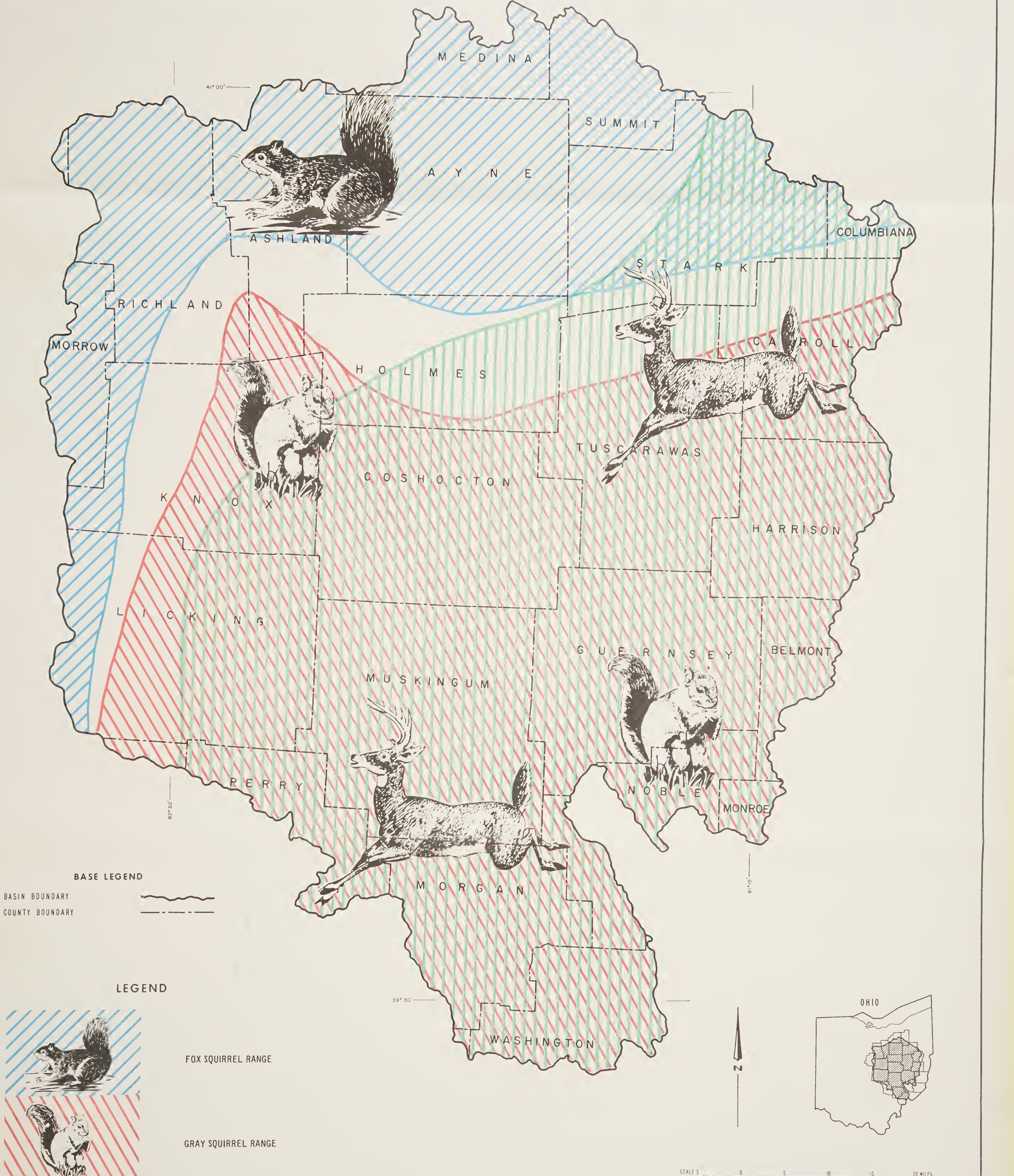
Land uses in the Muskingum River Basin provide ample habitat for a variety of wildlife species. In the northern and western Basin counties where farmland is prevalent, cottontail rabbits, fox squirrels, mourning doves, bobwhite quail, and ringnecked pheasants are the most abundant game species. Whitetailed deer, ruffed grouse and gray squirrels are also present in these counties, but are more abundant in the larger tracts of timber in the southern portion of the Basin.

The following two pages show relative abundances of some of the common wildlife species in Ohio as determined by the Ohio Department of Natural Resources, Division of Wildlife.

The 1.8 million acres of forest land (primarily hardwoods) in the Basin are located mainly in the central, southern, and eastern areas. As shown by Maps 2-9 and 2-10, these areas are the primary ranges of deer, grouse, and gray squirrel. The mourning dove, pheasant, and fox squirrel prefer the more open farmland to the north and west. Quail and rabbit have a wider distribution in the Basin (Maps 2-11 and 2-12).

Wild turkey was introduced in southeastern Ohio in 1952 and has become reestablished to a fair degree. Wild turkeys have been found in the Perry, Morgan, and Washington County portions of the Muskingum River Basin.

U. S. DEPARTMENT OF AGRICULTURE



PRIMARY RANGES
FOX AND GRAY SQUIRREL, WHITE-TAILED DEER

MUSKINGUM RIVER BASIN
OHIO

MAP 2-9

SOURCE: FAMILY OF MAPS SCS DRAWING NO. 5,R-32,783 (1-30-74) AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION.

USDA-SCS-LINCOLN, NEBR. 1974

9-12-74
5,P-34,360

PRIMARY RANGES
RUFFED GROUSE, MORNING DOVE RING-NECKED PHEASANT
MUSKINGUM RIVER BASIN
OHIO

MAP 2-10

SOURCE: FAMILY OF MAPS SCS DRAWING NO. 5,R-32,783 (1-30-74) AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION.

USDA-SCS-LINCOLN, NEBR. 1974

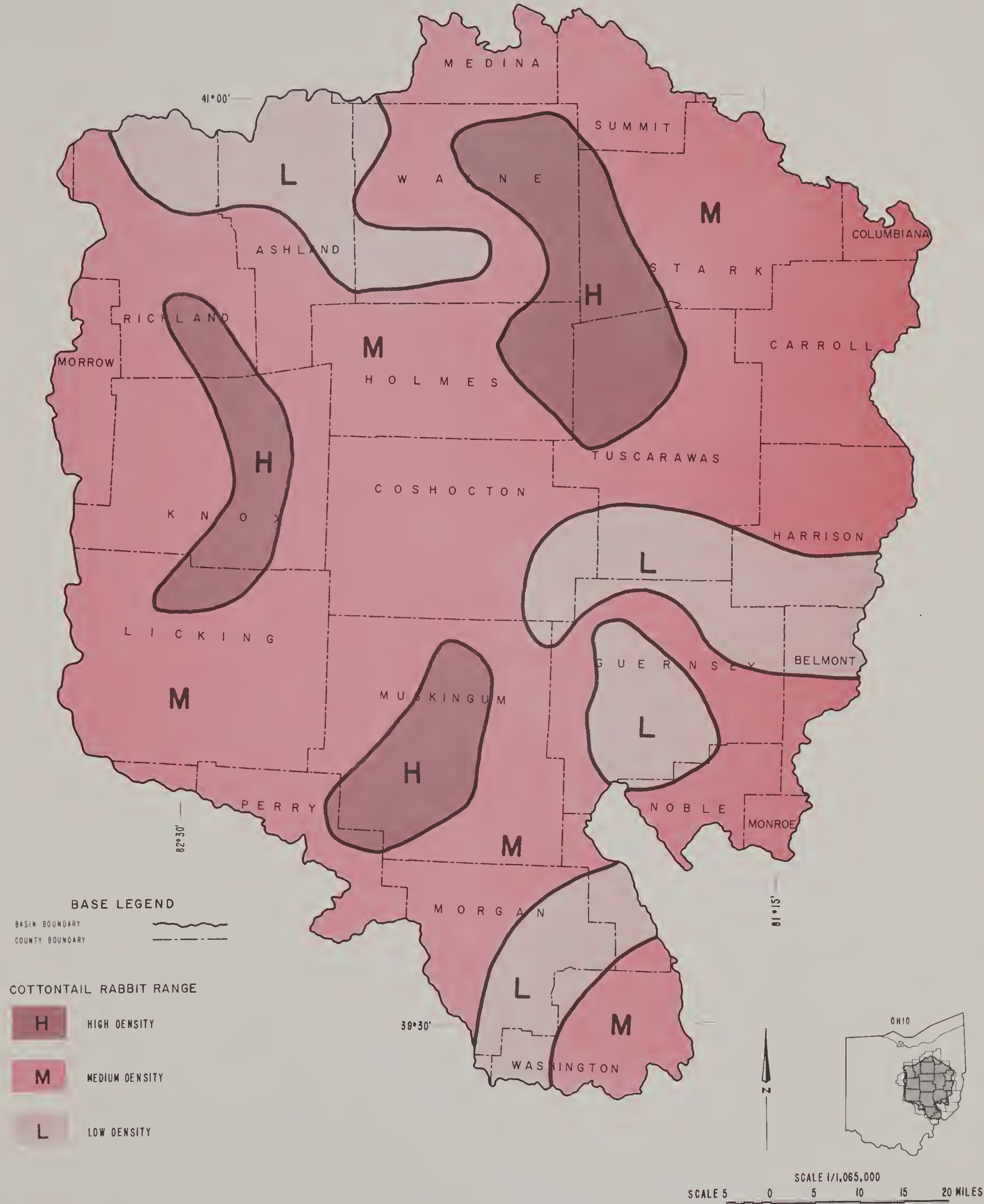
9-12-74
5,P-34,361

MAP 2-11

COTTONTAIL RABBIT RANGE

MUSKINGUM RIVER BASIN

OHIO



SOURCE:
FAMILY OF MAPS SCS DRAWING NO. 5,R-32,783 (1-30-74) AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION.

7-12-74
5,N-34,362

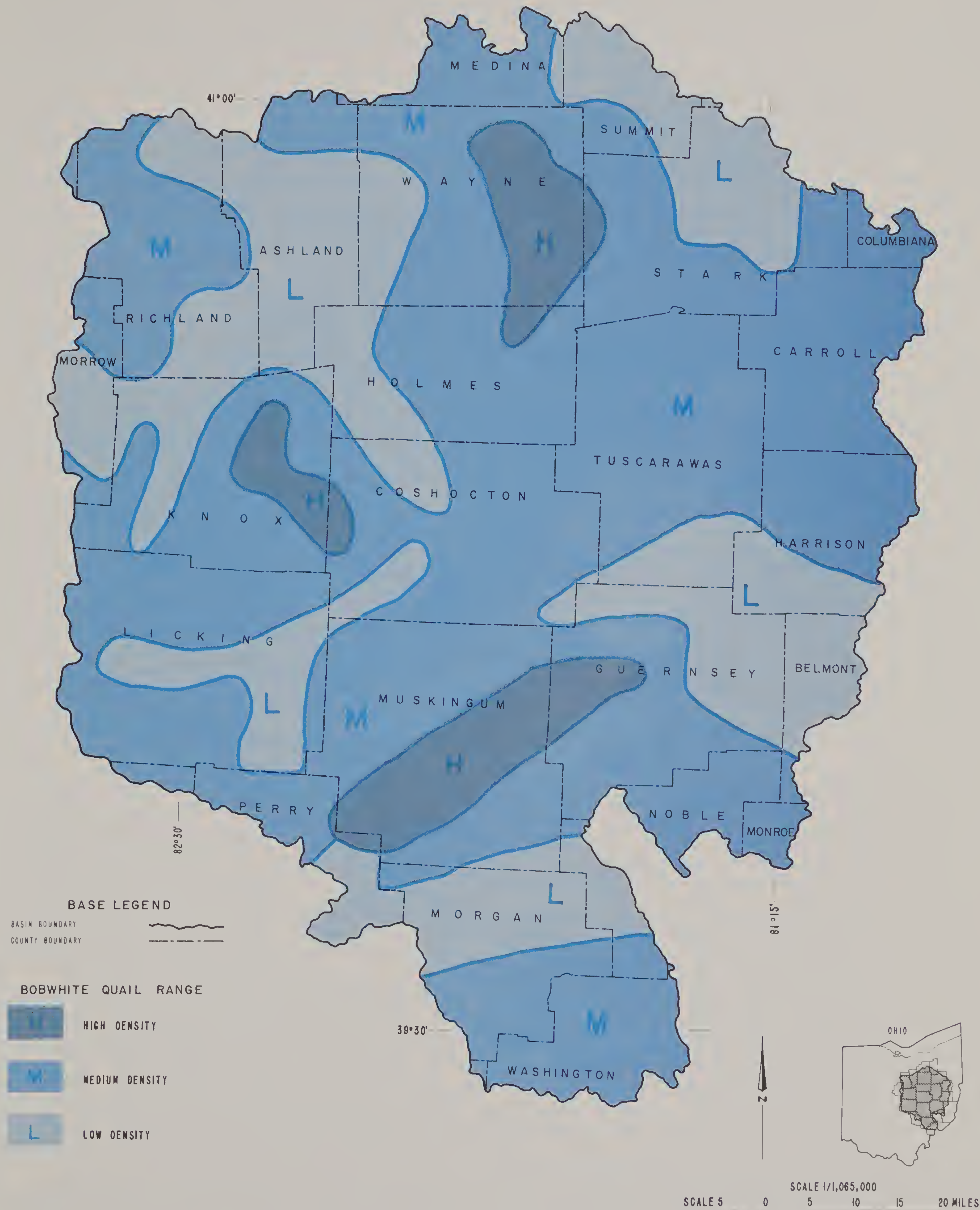
USDA-SCS-LINCOLN, NEBR. 1974

MAP 2-12

BOBWHITE QUAIL RANGE

MUSKINGUM RIVER BASIN

OHIO



SOURCE:
FAMILY OF MAPS SCS DRAWING NO.
5,R-32,783 (1-30-74) AND INFORMATION
FROM FIELD TECHNICIANS. TRANSVERSE
MERCATOR PROJECTION.

USDA-SCS-LINCOLN, NEBR. 1974

7-12-74
5,N-34,363

Major furbearers in the Basin (based on total Ohio fur sales in 1968-69) are: muskrat (Ohio's most valuable furbearer), raccoon, opossum, mink, red fox, skunk, weasel, gray fox, and beaver.

Ohio has about 250,000 acres of waterfowl habitat, much of which is found in the Muskingum River Basin (Map 2-13). The Ohio Division of Wildlife reports that mallards, black ducks, wood ducks, and greenwinged teal constitute about 70 percent of Ohio's annual harvest of 100,000 to 150,000 waterfowl. Other ducks which pass through the Muskingum River Basin include: greater scaup, bufflehead, widgeon, pintail, blue-winged teal, and redhead. Canada geese are found in the Basin and attract a limited amount of hunting.

Non-game mammals such as the woodchucks, red fox, and gray fox provide some hunting during closed seasons for game species.

The abundance of streams, reservoirs, and farm ponds well distributed throughout the Basin provide much high quality warm water fish habitat. Game fish found in this area of Ohio include: smallmouth bass, largemouth bass, white bass, bluegill sunfish, white crappie, black crappie, channel catfish, muskellunge, northern pike, and walleye.

G. Outdoor Recreation Resources

The Ohio Department of Natural Resources published A Statewide Plan for Outdoor Recreation in Ohio 1971-1977. Part I, "Inventory and Resource Analysis," includes a detailed listing of recreational areas by counties. Existing recreation resources, as described in this section, are for the 19 counties in the MREA. Approximately 312,872 acres are managed for recreational purposes. The water surface area supporting boating is 54,300 acres; 26,052 acres of which are streams. Table 2-5 displays the distribution of recreational areas by counties. Map 2-14 shows the more important recreational areas within the Basin. Following is a description of the recreational resource by activity.

Boating includes all activities (including fishing) taking place on water and involving some form of

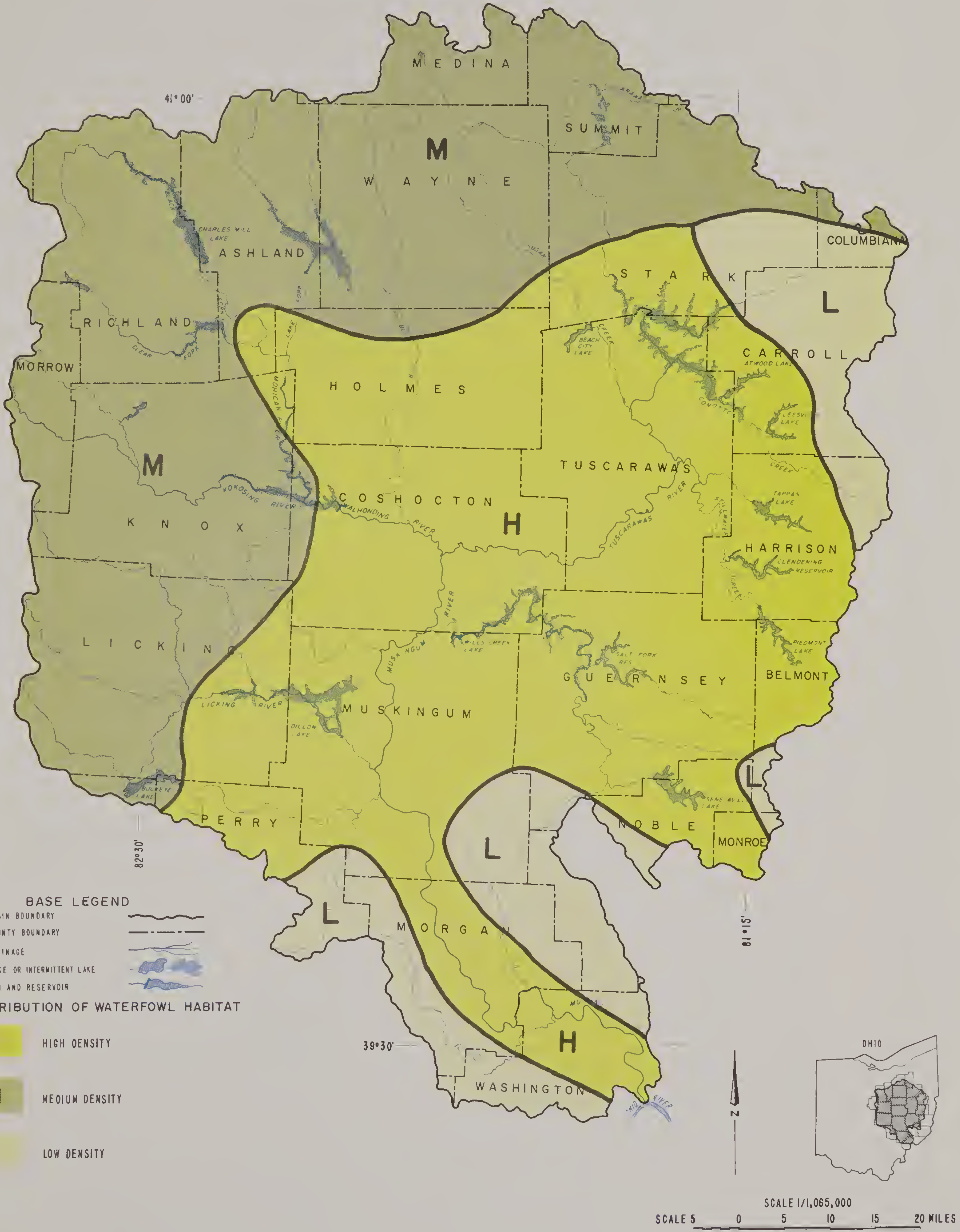
U. S. DEPARTMENT OF AGRICULTURE

MAP 2-13

DISTRIBUTION OF WATERFOWL HABITAT

MUSKINGUM RIVER BASIN

OHIO



SOURCE:
FAMILY OF MAPS SCS DRAWING NO.
5,R-32,783 (1-30-74) AND INFORMATION
FROM FIELD TECHNICIANS. TRANSVERSE
MERCATOR PROJECTION.

7-12-74
5,N-34,364

USDA-SCS-LINCOLN, NEBR. 1974

U. S. DEPARTMENT OF AGRICULTURE

BASE LEGEND

BASIN BOUNDARY
COUNTY BOUNDARY
COUNTY SEAT
TOWN OVER 5,000
TOWN 1,000 - 5,000
DRAINAGE
LAKE OR INTERMITTENT LAKE
DAM AND RESERVOIR
INTERSTATE HIGHWAY
FEDERAL HIGHWAY

LEGEND

STATE PARK OR RESERVE
MUSKINGUM CONSERVANCY DISTRICT
UNDER MANAGEMENT AGREEMENT WITH THE OHIO DIVISION OF WILDLIFE
OWNED BY OHIO POWER CO.
UNDER MANAGEMENT AGREEMENT WITH THE OHIO DIVISION OF WILDLIFE
HUNTING
FISHING
PARKWAY AND RECREATION AREA
HISTORICAL SOCIETY SITE
ROADSIDE PARK
RECLAMATION AREA

SCALE 5 0 5 10 15 20 MILES
SCALE 1/750,000

RECREATION RESOURCES
MUSKINGUM RIVER BASIN
OHIO

MAP 2-14

SOURCE: FAMILY OF MAPS SCS DRAWING NO. 5,R-32,783 (1-30-74) AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION.

USDA SCS-LINCOLN, NEBR. 1974

9-12-74
5,P-34,365

TABLE 2-5
RECREATION INVENTORY OF MREA, OHIO

Sheet 1 of 2

Counties	Area for Out-door Games and Sports In Acres	Number of Camps	Area for Boating In Acres	Shoreline Length In Miles
Ashland	185	7	1394	165
Carroll	136	14	2896	29
Coshocton	127	6	2477	179
Guernsey	81	1	4142	104
Harrison	18	6	4610	43
Holmes	15	8	548	64
Knox	64	7	1309	142
Licking	187	6	1629	241
Medina	194	9	1020	118
Morgan	126	1	2242	114
Muskingum	196	4	3757	113
Noble	343	2	3395	84
Perry	366	3	963	41
Richland	182	11	2399	90
Stark	1049	5	2010	254
Summit	858	13	3614	150
Tuscarawas	321	5	2280	194
Washington	261	2	13189	330
Wayne	283	5	426	113
TOTAL	4992	115	54300	2568

TABLE 2-5
RECREATION INVENTORY OF MREA, OHIO

Sheet 2 of 2

Counties	Total* Recreation Acres	Area of Beaches or Pools in Acres	Number of Golf Holes	Area of Land Based Activities in Acres	Area of Hunting Lands in Acres
Ashland	12589	9	63	10261	114717
Carroll	16124	14	18	12013	89840
Coshocton	13229	6	63	10200	122873
Guernsey	26444	6	27	21909	127756
Harrison	24673	6	18	18979	82696
Holmes	3689	7	9	2598	110776
Knox	10338	10	45	3152	130546
Licking	6265	14	117	3591	151020
Medina	9340	19	297	4705	83313
Morgan	33295	4	18	31285	89316
Muskingum	31310	14	72	22372	148246
Noble	17976	7	9	13953	90416
Perry	33073	8	9	26718	101076
Richland	10692	14	81	5914	108448
Stark	10785	36	360	4207	96812
Summit	21561	43	513	11332	23829
Tuscarawas	8204	87	423	4901	105955
Washington	19650	10	36	17113	126657
Wayne	3635	8	45	1519	152712
TOTAL	312872	322	2223	226722	2057004

* Does not include lands requiring permission to hunt.

watercraft. Boating occurs on 107 bodies of water of which 22 have a water surface larger than 200 acres. Table 2-6 is a listing of the 22 largest reservoirs. Senecaville Reservoir, built by the Corps of Engineers and managed by the Muskingum Watershed Conservancy District, has a water area of 3550 acres. Berlin Reservoir, administered by the Corps of Engineers, is located outside the Muskingum Basin hydrologic boundary but partly within Stark County which is within the MREA. Reservoir area is 3336 acres. Nine of the 107 lakes are between 50 and 200 acres, 34 between 10 and 50 acres, and 42 are 10 or less acres. The combined lake and stream surface areas for boating in each county is tabulated in Table 2-7.

Shoreline Fishing includes fishing activities taking place along streams, rivers, ponds, lakes, and reservoirs. Fishing from boats has been included as a boating activity. Fishing is permitted on all except six lakes (44 acres) where boating is permitted. Many other lakes permit fishing where boating is banned. Included are 42 lakes (1560 acres) with surface areas equal or greater than 10 acres. Small lakes provide an additional area of 1049 acres. A large portion of this area (639 acres) is within the Muskingum Recreation area. Owned by the Ohio Power Company, the area is reclaimed strip mine land which has been opened to the public. Also, numerous farm ponds scattered throughout the Basin is a resource for use by family and friends of the land owner.

For boating, the 26,052 acres of streams and rivers is a significant resource. The Division of Wildlife of the Ohio Department of Natural Resources has obtained easements to about 120 miles of streams. Many of the parks which abut or encompass streams provide access for fisherman. Table 2-5 lists lake and stream shoreline miles for each county. Access problems limit the usage on much of the stream shoreline.

Swimming takes place at beaches or pools. A 50 x 70 pool with appropriate deck area can be expected to accommodate about 400 users at one time, which is equivalent to the capacity of one acre of beach. There are 269 swimming areas in the MREA. Table 2-5 shows the area of beaches or pools for each county.

TABLE 2-6
RESERVOIRS GREATER THAN 200 ACPES IN AREA
ON WHICH BOATING IS PERMITTED
MREA, OHIO

Name of Lake	County	Administrating Agency	Water Area (Acres)
Atwood Lake	Carroll - Tuscarawas	MWCD	1540
Beach City	Tuscarawas	MWCD	420
Berlin	Stark - Mahoning - Portage	Corps of Engineers	3336*
Buckeye Lake	Fairfield - Perry - Licking	DNR	2853*
Burr Oak	Morgan - Athens	DNR	704
Charles Mill	Ashland - Richland	MWCD	1350
Chippewa Lake	Medina	Private	309
Clear Fork Reservoir	Richland	Mansfield - DNR	1010
Clendening Lake	Harrison	MWCD	1800
Dillon Lake	Muskingum	DNR	1330
Knox Lake	Knox	DNR	495
Lake Mohawk	Carroll	Private	507
Leesville Lake	Carroll	MWCD	1000
Nimisila Reservoir	Summit	DPW - DNR	811
Piedmont Lake	Belmont Harrison - Guernsey	MWCD	2270*
Pleasant Hill Reservoir	Ashland - Richland	MWCD	850
Portage Lakes	Summit	DNR	1198
Salt Fork	Guernsey	DNR	2952
Seneca Lake	Guernsey - Noble	MWCD	3550
Tappan Lake	Harrison	MWCD	2350
Wills Creek	Coshocton - Muskingum	MWCD	900
Wolf Creek	Noble	DNR	220
		TOTAL	31755

*Includes surface area outside the MREA.

TABLE 2-7
Total Lake and Stream Surface Area By County
In MREA on Which Boating is Permitted

Counties	Total Lake Area (Acres)	Total Stream Area (Acres)	Total Lake and Stream Surface Area (Acres)
Ashland	702	692	1,394
Carroll	2,811	85	2,896
Coshocton	765	1,712	2,477
Guernsey	3,652	490	4,142
Harrison	4,510	100	4,610
Holmes	258	290	548
Knox	501	808	1,309
Licking	785	844	1,629
Medina	602	418	1,020
Morgan	664	1,578	2,242
Muskingum	1,583	2,174	3,757
Noble	3,099	296	3,395
Perry	892	71	963
Richland	2,010	389	2,399
Stark	1,202	808	2,010
Summit	3,051	563	3,614
Tuscarawas	805	1,475	2,280
Washington	183	13,006	13,189
Wayne	173	253	426
TOTAL	28,248	26,052	54,300

Golf includes activities at both public and private facilities. Supply includes all public, private, and par-3 courses, but does not include driving ranges and miniature golf installations. Within MREA there are 2,223 golf holes. Table 2-5 displays the distribution of holes among the counties.

Land-oriented activities such as camping, picnicking, and hiking are included. Land-oriented activities take place on all lands managed for recreational pursuits except scenic highways, areas along streams acquired for fishing easements, lands used exclusively for hunting, golf courses, and other unique areas. Total area available for land based activities is 226,722 acres. Table 2-5 shows how they are distributed among the counties. During the last several years, there has been an increase emphasis on providing foot and bicycle trails. The State of Ohio jointly with the Buckeye Trail Association established the Buckeye Trail. The trail starts in Cincinnati and extends across the State, traversing the Muskingum Basin, to Cleveland. Other trails within MREA are:

1. Captain Bates Trail - A hiking trail through historic sites near Seville, Ohio. 11.5 miles.

2. Cuyahoga Trail - A hiking trail which follows, in part, old canal towpath sites of early engineering achievement and scenic beauty. 13.1 miles.

3. Mansfield Fun Center Bikeway.

4. Johnny Appleseed Trail - A hiking trail which goes from Copus Massacre Monument near Charles Mill to Mohican State Park. 18 miles.

5. Flint Ridge Trail - A hiking trail from Canal Monument at Heath to Flint Ridge State Memorial. 19.2 miles.

6. The Wilderness Trace - Cross-country foot trail in Wayne National Forest land near Straitsville. 20 miles.

Pleasure driving includes trips made primarily for sight seeing or viewing natural scenery, and trips to and from recreational areas. The State of Ohio has designated and is managing many miles of scenic highways which traverse the MREA from which the scenic resource is enjoyed. Diversity in land forms, water areas, and land use patterns compose a cross section as varied as any within the State. Scenic routes go past Amish farmsteads, through areas rich in historic interests, to the hilly lands in the southern portion of the Basin. Here small farmsteads surrounded by pasture and woodland dominate the landscape. Sheep, cattle, and horses dot the fields. Good wildlife habitat generally exists along the streams. Idle or wet lands intersperse the cultivated fields. Sightings of birds and other wildlife add to the quality visual experience.

The rural area in northern Muskingum Basin is characterized by small towns separated by farm land. Farmsteads consist generally of large barns with one or more silos, a large house, and several special purpose buildings. Each farmstead takes on its own special character. On many barns is painted the farm name or a bit of Pennsylvania Dutch art. Several Amish communities intersperse the area. Despite the economic pressures which have caused neighboring farmers to adopt modern farming techniques, the Amish continue to maintain ties with nature that most people have abandoned. A landmark of the Amish community is the windmill.

Hunting includes the pursuit of all forms of wildlife classified as legal game animals in Ohio. The activity is permitted on approximately 2,057,004 acres. Public and private tracts open to the public account for 164,268 acres. The remainder, which is 51 percent of the agricultural land, are available for hunting but may require permission. Table 2-5 shows how the total total hunting land is distributed among the counties.

Outdoor games and sports include facilities such as playfields, courts, and play equipment which should be located near home. Most areas are managed by municipalities; however, privately managed establishments whose dominant use is court and field games is included in the inventory. Table 2-5 lists the acres for each county on which outdcor games and sports occur.

Camp organizations such as, boy and girl scout, church, youth, YMCA, and 4-H, have found quality sites for camping in the Basin. There are 115 camps distributed by counties as shown in Table 2-5.

All land managed for recreational purposes fall into one of the six classes established by the Bureau of Outdoor Recreation. Class I is high density recreation areas in which heavy expenditures are made for facilities. The purpose is to provide a large number of people an intensive recreational experience. Class II facilities provide an extensive day, weekend, and vacation use for such activities as camping, picnicking, fishing, hunting, water sports, nature walks, and outdoor games. The facility is not intended to serve as many people per acre as Class I and the activity is usually less intense. Class III is natural environment areas. The primary objective is to provide for traditional recreation experience in the out-of-doors, commonly in conjunction with other resource uses. Users are encouraged to enjoy the resource "as is", in natural environment. Class IV is outstanding natural areas. The scenic sites and features are limited in number and are irreplaceable. Developments are kept outside the area and visitors generally must walk to the natural area. Class V are extensive natural, wild, and undeveloped areas in settings removed from the sights, sounds, and smells of civilization. The essential characteristic is that the environment be undisturbed. Class VI is historical and cultural sites. Within the basin are 7458 acres of Class I, 77,719 acres Class II, 178,630 acres of Class III, 44,779 acres of Class IV, 0 acres of Class V, and 4286 acres of Class VI recreation land. Table 2-8 shows what portion of these totals are within each MREA county.

Management of the recreation land is as follows: 40,781 acres by Federal Government, 86,265 acres by State of Ohio, 1049 acres by counties, 9251 acres by cities, 122,864 acres by private entities, and 52,662 acres by other public units (Muskingum Watershed Conservancy District, etc.). (See Map 2-14)

TABLE 2-8
CLASSIFICATION OF RECREATION LAND BY THE
BUREAU OF OUTDOOR RECREATION
MREA, OHIO

	Class I		Class II		Class III		Class IV		Class V		Class VI	
	No.	Ac.	No.	Ac.	No.	Ac.	No.	Ac.	No.	Ac.	No.	Ac.
Ashland	18	257	23	3964	45	6205	4	2159	0	0	4	4
Carroll	14	158	31	6218	46	9254	4	491	0	0	3	3
Coshocton	15	369	15	1599	30	10475	6	780	0	0	6	6
Guernsey	9	131	16	21233	23	4564	8	510	0	0	6	6
Harrison	10	80	16	2808	30	21472	4	310	0	0	3	3
Holmes	7	25	7	623	36	2436	8	604	0	0	1	1
Knox	11	154	19	1183	37	8850	2	150	0	0	2	1
Licking	11	279	39	2618	15	2343	2	135	0	0	19	890
Medina	27	389	35	5191	57	3631	0	0	0	0	4	79
Morgan	7	76	12	3229	32	26793	7	3187	0	0	10	10
Muskingum	37	294	24	9784	25	20511	4	690	0	0	7	31
Noble	5	47	5	424	22	17351	5	140	0	0	14	14
Perry	14	187	15	2906	18	12037	3	17831	0	0	14	112
Richland	31	428	19	2464	32	5864	3	591	0	0	6	1345
Stark	113	1374	45	4201	66	4820	3	388	0	0	4	2
Summit	110	2122	51	5376	55	12188	3	510	0	0	12	1365
Tuscarawas	34	352	29	2096	52	4932	3	508	0	0	10	316
Washington	36	335	25	1162	36	2421	5	15715	0	0	17	17
Wayne	21	401	12	640	32	2433	1	80	0	0	2	81
TOTAL		7458		77719		178630		44779		0		4286

H. The Natural Environment

1. Scenic Beauty

The natural range in topography, vegetation, and geologic conditions provides variety throughout the Basin. The northern portion of the Basin was glaciated and now consists of moderately rolling till plains with a predominance of farm land and urban development interspersed by small scattered wooded areas. The Kokosing, Mohican, and Tuscarawas Rivers wind through this northern half of the Basin.

In contrast, the southern part of the Basin is more rugged, with many steeper forested slopes and hills noted for their beautiful autumn foliage and the green of pines in the winter season.

The uniqueness of hillside springs, marshes, and wetland areas have created many unusual plant associations. Meandering streams through the valleys with well-kept farmsteads nestled in the wooded hillsides, are picturesque sights. Conglomerate rock outcroppings and glacial erratics also add to the natural beauty in the Basin.

2. Destructive Factors

The scenic beauty of the Basin is locally marred by the scars of past and present strip mining operations, principally in the eastern and southern sections of the Muskingum Basin. Some of these wastelands have been planted with trees and grasses to reduce their barrenness, restore some beauty, and as a practical measure, to prevent erosion which leads to sedimentation and stream pollution.

In some areas of the southern portions of the Basin, fires have left their marks on the forested hills. Judicious planting and time will heal these scars and restore the scenic views to their former natural beauty.

There are no extensive outbreaks of either forest pest insects or diseases in Ohio. Existing problems are mostly disease-caused damages and timber value losses.

The most prevalent defoliater in or close to the Muskingum River Basin is the forest tent caterpillar found mainly along the Ohio River counties from Steubenville southward. This worm creates unsightly trees, but rarely kills them. The deleafing does slow growth of the timber. In young oak stands, with stems up to six inches in diameter, the oak borers do some degrading damage, although generally the stands do not contain much high grade material. Bagworm infestations also occur locally in the Basin but do little damage. Both bagworm and tent caterpillars can be reduced in number by careful application of chemical pesticides or biological controls.

Oak wilt damage is very light in Ohio, averaging perhaps one tree per square mile, or no more than are struck by lightning during a year.

Occasionally some white pine root decline infests trees in the white pine plantations, but this has been of very low occurrence.

Dutch elm disease has wiped out most of the elm in Ohio. New varieties are being bred to resist the disease.

A more modern threat to the forests is the effect of air pollution on trees in the vicinity of industrial areas. Chemicals from the smoke stacks can weaken trees and make them more susceptible to disease, insects, and fungi attacks.

Chapter 3

ECONOMIC DEVELOPMENT

MUSKINGUM RIVER BASIN

Chapter 3. Economic Development

A. Historical Development

B. General Description
   1. Population
   2. Employment and Growth Characteristics
   3. Income
   4. Urban Centers and Their Influence
   5. Urban Centers
   6. Land Use
   7. Transportation

C. Agriculture and Related Economic Activity
   1. Major Crops: Acreage, Production, and Value
   2. Major Livestock Enterprises
   3. Agricultural Employment
   4. Rural Farm Income
   5. Agriculturally Related Employment and Income

D. Outdoor Recreation and Related Economic Activity

E. Forestry and Related Economic Activity
   1. Extent and Nature of the Resource
   2. Utilization: Kind, Volume, and Value of Output
   3. Employment in Forest Related Industries

F. Relationship of Economic Development and Water Resource Development

A. Historical Development

Historic interests such as the first non-Indian settlement within the state, Moravian Missionaires in 1761, was in the Basin. Delaware Indians occupied much of the Muskingum Valley at the time. Historic and archeological interest points dating to Indian times are scattered throughout the Basin. Moundbuilders State Memorial, Octagon Mound State Memorial, and Wright Earthworks State Memorial are located in Newark. Restored Indian villages are located along the Tuscarawas River. Zoar State Memorial is a Registered National Landmark. The village was settled by a group of Germen separatists as a religious community. When land debts became impossible to meet a communal life style developed. Schoenbrunn was the first settlement in Ohio. Nearby Gnadenhutten is the memorial for 96 Christian Indians massacred by Pennsylvania militiamen. As the newly established communities took root the need for good access to eastern cities for markets and imports became apparent. An inland water transportation system of canals was developed. Remnants of the time, traces of locks, tunnels, aqueducts, and canals, abound. Towns sprung up along the system. Some of the original buildings are still in existance.

Excavation began on the Ohio-Erie Canal on July 1, 1825, at the Licking summit level, three miles west of Newark. On December 1, 1832, the Ohio-Erie Canal was declared open. Impressed with prosperity resulting from improved markets, the state began spending heavily for additional canal construction. The Walhonding Branch was completed. From the main canal near Coshocton the canal extended northwest to nowhere in particular. Work on making the Muskingum River navigable also began in 1836.

The greatest failure among the Ohio canals was the Sandy and Beaver. Construction began in 1834 but was not completed until 1846, when railroads were already invading Ohio. The most intriguing historic remnant is the 3180 foot tunnel joining the Beaver and Sandy Creek Basins. The tunnel was deliberately made too narrow for a towpath. Boats were pulled by an endless chain attached to a mule powered treadmill. During the spring of 1850, an average of 10 boats a day were

passing. Two years later the tunnel was abandoned. In 1866 the Federal Government acquired the Muskingum navigation system and rebuilt all structures except the lock and dam above Zanesville. River traffic then reappeared, reached a peak in 1943 but declined as coal deposits along the river were exhausted.

Over the years the Muskingum Basin has contributed significantly to the economy of the State. Although a large acreage of marginal land has been taken out of cultivation, agricultural production continues to be impressive. The Basin has continued in industrial importance that includes the processing of primary metals, machinery, electrical machinery and equipment, fabricated metal products, stone, clay, glass products, chemicals, coal, oil, gas, electrical power, forest related products, and others.

Water management in the Basin has played a crucial role in economic development. As in most basins, the twin problems of excess water during floods and inadequate water at the right place for urban and industrial development had to be solved. A coordinated effort to control floods was begun about 1930 when the cities of Zanesville and Marietta sponsored a survey of the problem by the Dayton Morgan Engineering Company. The Muskingum group became one of the first to request Federal aid when the Public Works Administration was established in 1933 to combat unemployment. To establish a legal entity to sponsor water management projects in the region, the Muskingum Conservancy District was created by court decree on June 3, 1933. This body was given broad authority for constructing and operating water management projects. It still functions as a vital force in the economic and environmental development of the region. The District has served over the years as a classic example of local initiative and control in water resource management. 1/

1/ For a detailed summary of the founding and functioning of this body, see "The Muskingum Watershed Conservancy District: A Study of Local Control," by Dr. Lyle E. Craine, School of Natural Resources, University of Michigan. This paper was published in Law and Contemporary Problems Duke University School of Law, 1957.

B. General Description

Economic data in this section are reported for 19 counties having all or a major portion of their land area within the Muskingum River Basin boundaries. Throughout this chapter the expression Muskingum River Economic Area (MREA) or "the basin" should be taken to mean the entire area of the 19 counties (Map 1-1). This is necessary because data used in the analysis are for entire counties and could not be accurately disaggregated to the portion of the county lying inside the watershed boundary.

The area's economy is characterized by industrialized urban centers and dairy farms on the north, corn belt type farming in the west, and coal mining, rolling to hilly topography, and beef farming in the south and southeast. Counties in the center of the basin represent a transition zone having some characteristics of each of the areas already mentioned. The counties in the west tend to use larger equipment, produce more feed grains and do more livestock feeding than the rest of the Basin. Counties in the southern part of the basin generally have a larger percentage of part-time farmers and do more cow-calf beef farming than the remainder of the basin.

1. Population

In 1970 the 19 MREA counties had 15.7 percent of Ohio's population on 23.2 percent of the State's land area. MREA had 184 people per square mile in 1970 compared to 236 for the State and 51 for the United States. From 1950 to 1960 population grew two percent per year in MREA compared to 2.2 percent for the State. These rates of growth fell to .8 percent annually for MREA and one percent annually for the State during 1960 to 1970. In comparison, the adjoining States of Indiana and Kentucky had annual increases of 1.1 percent and 0.6 percent, respectively, over the same ten year period. Six MREA counties lost population from 1960 to 1970. These were Guernsey, Harrison, Morgan, Muskingum, Noble, and Perry (Maps 3-1 and 3-2). The population of some cities and villages also declined (Table 3-1).

The farm population as a percentage of the total population has been declining quite rapidly and will continue

Table 3-1
Selected Population Characteristics by Subarea Historical and Projected, Muskingum River Basin, Ohio 1/

Sub-Area	Item	1950	1960	1970	1980	2000	2020
1	Total Population	792,359.0	994,726.0	1,095,421.0	1,330,400.0	1,707,800.0	2,207,900.0
	Pct. annual growth 2/	*	2.5	1.0	2.1	1.4	1.4
	Pct. urban	74.4	75.3	77.6	(79.0) 3/	(80.0)	(81.0)
	Pct. rural	25.6	24.7	22.4	(21.0)	(20.0)	(19.0)
	Number rural farm	53,880.0	29,842.0	*	20,178.0	14,228.0	13,588.0
	Pct. rural farm	*	3.0	*	2.1	1.4	1.4
2	Total Population	230,277.0	285,582.0	322,894.0	398,000.0	532,000.0	726,100.0
	Pct. annual growth	*	2.4	1.3	2.0	1.8	1.8
	Pct. urban	54.1	55.9	57.4	(59.0)	(60.0)	(61.0)
	Pct. rural	45.9	44.1	42.6	(41.0)	(40.0)	(39.0)
	Number rural farm	43,292.0	27,416.0	*	16,710.0	12,522.0	11,853.0
	Pct. rural farm	18.8	9.6	*	4.3	2.4	1.6
3	Total Population	153,314.0	169,456.0	172,313.0	208,000.0	280,500.0	365,100.0
	Pct. annual growth	*	.7	.1	2.0	1.7	1.5
	Pct. urban	36.2	37.9	37.5	(38.0)	(39.0)	(40.0)
	Pct. rural	63.8	62.1	62.5	(62.0)	(61.0)	(60.0)
	Number rural farm	44,173.0	26,774.0	*	19,384.0	13,802.0	12,547.0
	Pct. rural farm	27.9	15.8	*	9.3	4.9	3.4
4	Total Population	210,979.0	221,020.0	222,888.0	263,700.0	314,600.0	265,300.0
	Pct. annual growth	*	.5	.1	1.8	.9	.8
	Pct. urban	37.2	37.7	36.7	(37.0)	(37.5)	(38.0)
	Pct. rural	62.8	62.3	63.3	(63.0)	(62.5)	(62.0)
	Number rural farm	52,956.0	26,301.0	*	15,832.0	10,276.0	10,048.0
	Pct. rural farm	25.1	11.9	*	6.0	3.3	2.8

Table 3-1 cont'd

Sub-Basin	Item	1950	1960	1970	1980	2000	2020
Muskingum River Basin							
	Total Population	1,391,929.0	1,670,784.0	1,813,516.0	2,192,000.0	2,835,200.0	3,664,400.0
	Pct. annual growth	*	2.0	8.0	2.0	1.5	1.5
	Pct. urban	63.9	63.2	65.1	*	*	*
	Pct. rural	36.1	36.8	34.9	*	*	*
	Number rural farm	194,298.0	110,333.0	*	72,104.0	50,824.0	48,036.0
	Pct. rural farm	13.9	6.6	*	3.3	1.8	1.3

1/ Projections to 1980, 2000, and 2020 were made prior to publication of the 1970 Census data. The projected annual increase 1960-1980 for SEO was 27,844. The annual increase 1960-1970 as reported by the Census was 10,069 or less than halfthe projected rate of increase.

2/ Average percent annual growth over preceeding 10 years.

3/ All figures in parenthesis are estimates based on historical trend.

* Indicate figures were not readily available.

Table 3-2

Rural Farm Population[1/] as a Percent of Total Population by Subarea
Muskingum River Basin, 1950, 1960, and Projected to 1980, 2000, and 2020

Subarea	Rural Farm Population as a Percent of Total Population				
	1950	1960	1980	2000	2020
1	6.8	3.0	2.1	1.4	1.4
2	18.8	9.6	4.3	2.4	1.6
3	27.9	15.8	9.3	4.9	3.4
4	25.1	11.9	6.0	3.3	2.8
Muskingum Basin Total	13.9	6.6	3.3	1.8	1.3

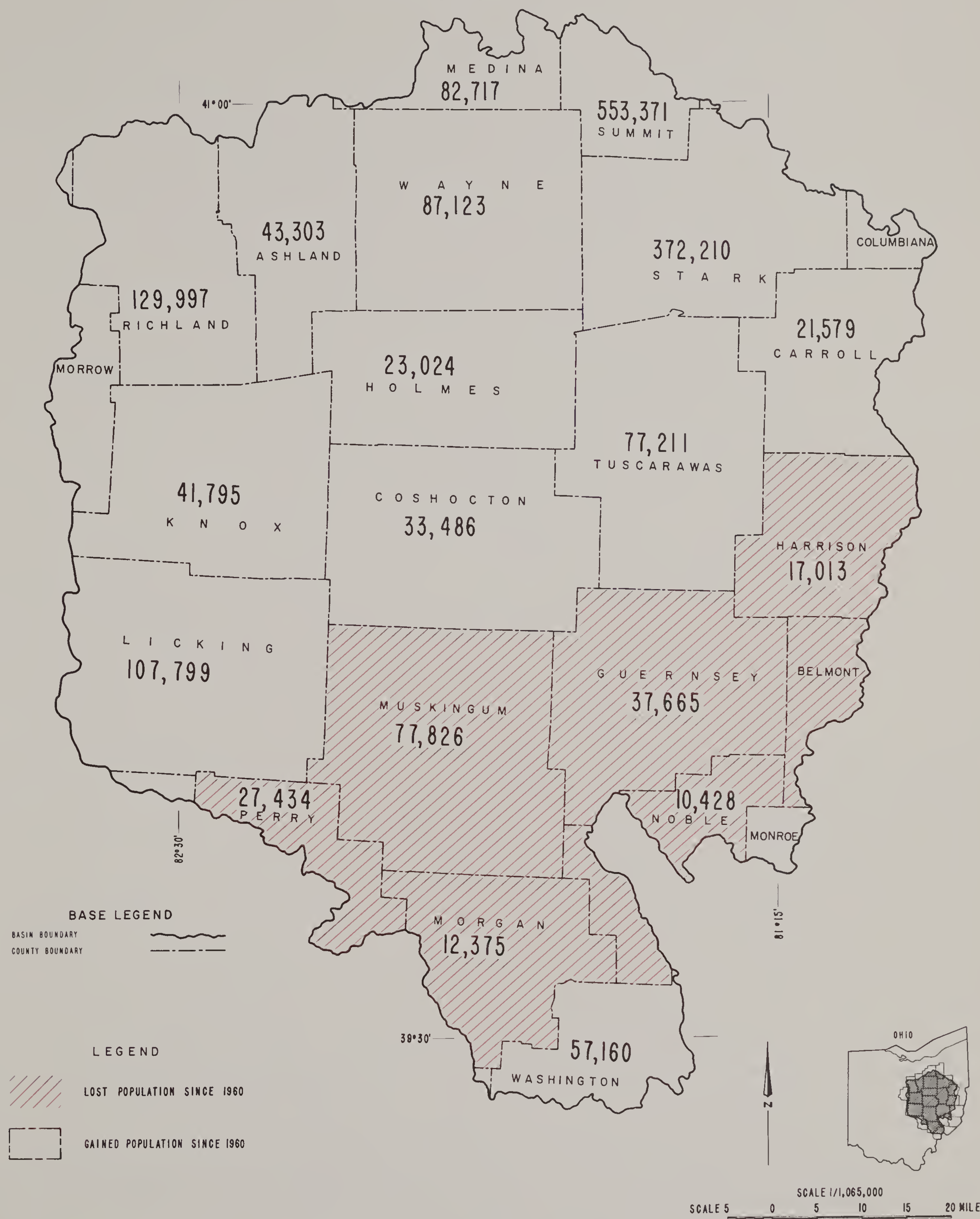
1/ Based on "Without Development" Projections.

MAP 3-1

1970 POPULATION BY COUNTIES

MUSKINGUM RIVER BASIN

OHIO



SOURCE:
FAMILY OF MAPS SCS DRAWING NO. 5,R-32,783 (1-30-74), ECONOMIC RESEARCH SERVICE, AND INFORMATION FROM FIELD TECHNICIANS.
TRANSVERSE MERCATOR PROJECTION.

7-12-74
5,N-34,366

USDA-SCS-LINCOLN, NEBR. 1974

U. S. DEPARTMENT OF AGRICULTURE

MAP 3-2

PERCENT POPULATION CHANGE BY COUNTIES
(STATE AVERAGE = 9.7) 1960-1970
MUSKINGUM RIVER BASIN
OHIO

SOURCE:
FAMILY OF MAPS SCS DRAWING NO. S,R-32,783 (1-30-74), ECONOMIC RESEARCH SERVICE, AND INFORMATION FROM FIELD TECHNICIANS.
TRANSVERSE MERCATOR PROJECTION.

7-12-74
S,N-34,367

USDA-SCS-LINCOLN, NEBR. 1974

to do so (Table 3-2 and Figure 3-1). It may comprise only about one percent of the total population by 2020. Validity of numbers in Table 3-2 depend on the assumption that farmers will continue to adopt and use fertilizer and machinery and plant technology currently available. Fertilizer adds chemical pollutants to streams and large machines make impractical some erosion control practices, such as terraces. Environmental constraints could be introduced through legislation that would limit the amount of fertilizer and use of large labor saving machinery.

2. Employment and Growth Characteristics

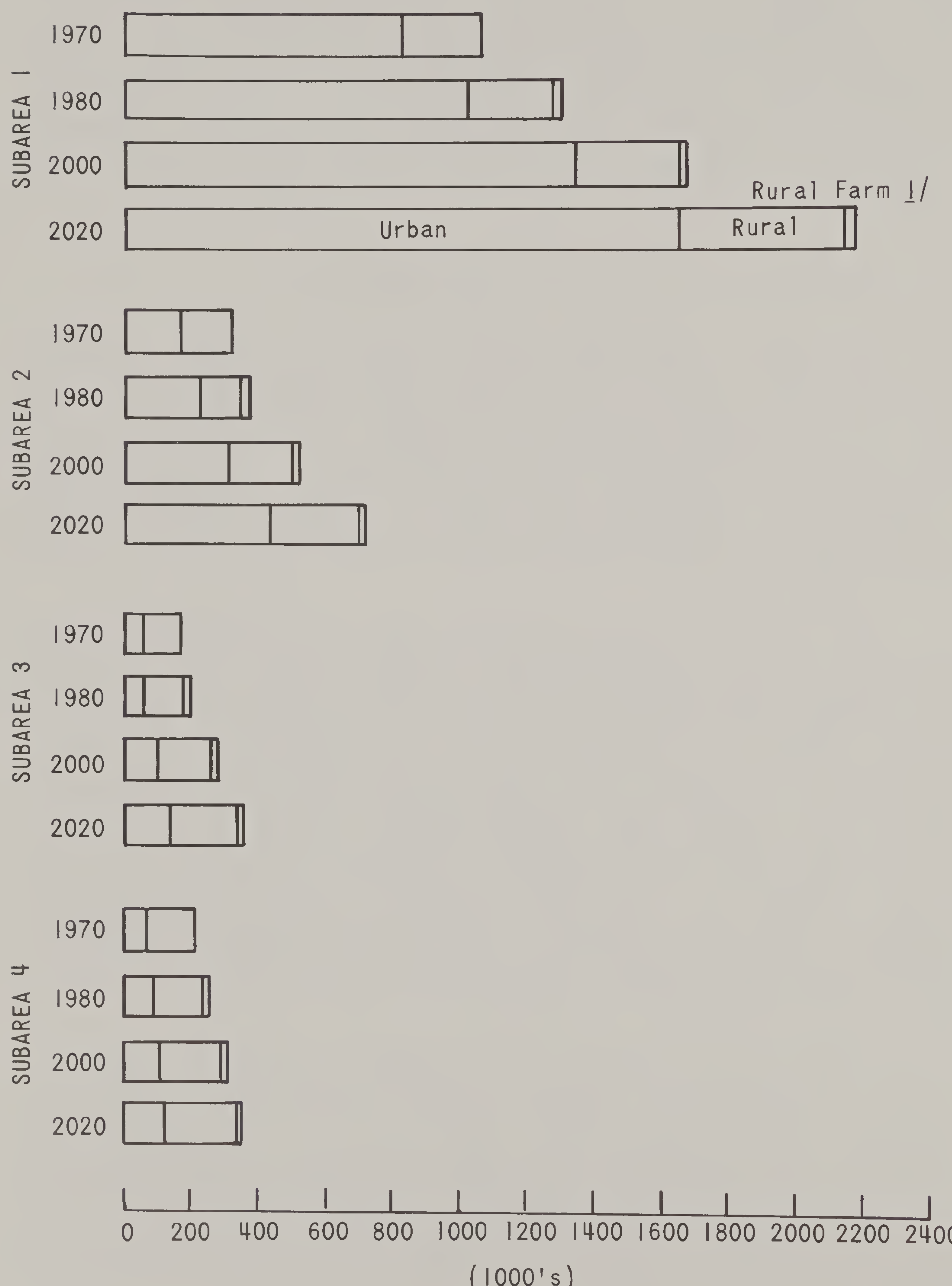
Figure 3-2 is a graphic display of the relative amounts of employment in the major areas of MREA economic activity in 1940, 1950, 1960, and 1970. Manufacturing was the largest employment group accounting for 57 percent of the MREA total employment. In 1966 the number of manufacturing jobs was estimated about 252,000 in MREA compared to 230,000 in 1960. Jobs in manufacturing increased by 45,000 from 1950 to 1960 but only by 27,000 from 1960 to 1970.

In 1969 jobs in tires, inner tubes and reclaimed rubber manufacturing accounted for about 50,000 jobs included in other and miscellaneous manufacturing. These are in Summit County primarily and presumably in the City of Akron which is on the edge of the Muskingum River Basin boundary. Other large employment categories which fall into the other and miscellaneous group include metal stampings, fabricated plate work, iron and steel forgings, internal combustion engines, special dies and tools, ball and roller bearings, motor vehicles and parts, aircraft equipment, and paper products. Manufacturing in MREA is well diversified and is concentrated in the area's northern counties.

Employment growth from 1960 to 1966 was highest in Medina County (34 percent increase) and it decreased in Harrison County which lost 10.8 percent of its employment. Carroll and Harrison both had employment decreases which probably reflected the adoption of labor saving equipment in the coal mining industry. Summit County had a very low percentage increase in employment (8.9 percent) but still had the largest absolute increase. Its employment

Figure 3-1

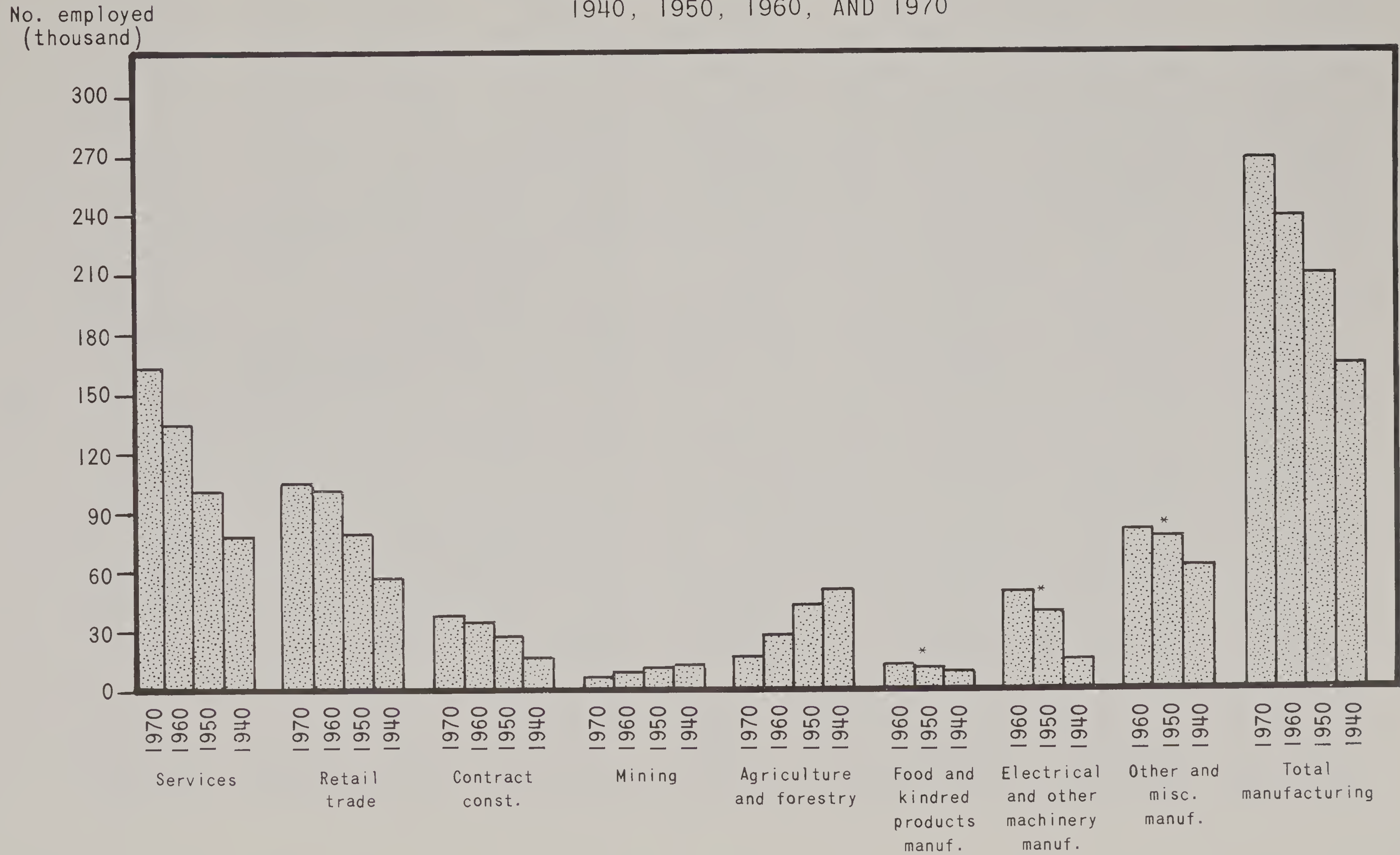
TOTAL, URBAN, AND RURAL POPULATION, MUSKINGUM RIVER ECONOMIC AREA, 1970 AND PROJECTIONS TO 1980, 2000, AND 2020



1/ RURAL FARM POPULATION WAS NOT AVAILABLE FOR 1970. PROJECTIONS WERE BASED ON MANPOWER EXPECTED TO BE REQUIRED TO PRODUCE THE PROJECTED QUANTITIES OF AGRICULTURAL PRODUCTS.

Figure 3-2

EMPLOYMENT IN MAJOR INDUSTRY GROUPS, MUSKINGUM RIVER ECONOMIC AREA, 1940, 1950, 1960, AND 1970



*1970 data not available for these subcategories of manufacturing.

increased by 13,063 between 1960 and 1966. Transportation, utilities, and communications as a combined category accounted for six percent of MREA employment in 1970. Retail trade and services were large with 15.5 and 24.5 percent, respectively, in 1970.

Agricultural employment declined from 8.4 percent of the total in 1950 to 2.6 percent in 1970 (Table 3-3). Data prepared by the State of Ohio show a rate of decline in agricultural employment in the State of about five percent annually from 1960 to 1967. Projections prepared by ERS indicate a three percent average annual rate of decline from 1964 to 1980 for MREA (Table 3-4). These projections will be heavily influenced by population trends which affect food requirements, by food and fiber producing technology, and by legislative action affecting the use of agricultural chemicals. If environmental legislation is passed restricting the use of chemicals it will likely cause more labor and other inputs to be used in agricultural production.

Most counties in MREA had a 30 to 40 percent increase in service industry employment. Some rural counties in the southern portion of the region had smaller increases in services resulting in a smaller overall MREA increase.

The only sector having a higher rate of increase than services was Federal Government Employment. This high increase was due largely to the location of a federal installation in Licking County which brought federal employment from 361 to 3,081. Federal employment in most counties increased by less than ten percent.

Employment in mining and quarrying decreased in all counties except Wayne, Knox, Licking, Morgan, and Noble. Net decrease for MREA in this sector was 11.9 percent. Although employment decreased in mining, total wages earned in mining increased from $42 million to $46 million between 1960 and 1966. Employment in transportation and utilities also gained slowly with an increase of 7.3 percent.

Stark and Summit Counties had a growth of about 21 percent in total effective buying income. The major portion of the current MREA economic growth is concentrated in these two counties which will probably account

Table 3-3
Employment in Selected Industries, Muskingum River Economic Area 1/
1940, 1950, and 1960

Industry Group	1940 Number Employed	1940 Percent of Basin Total	1940 Percent of State Industry Total	1950 Number Employed	1950 Percent of Basin Total	1950 Percent of State Industry Total
Agriculture and Forestry	52,899	13.4	20.5	43,514	8.4	20.4
Mining	10,526	2.7	32.5	10,167	2.0	33.2
Contract Const.	15,308	3.9	15.1	24,534	4.7	15.5
Manufacturing	145,888	36.8	18.6	209,593	40.3	18.7
Food and Kindred Products	7,195	1.8	13.6	8,826	1.7	14.2
Electrical and Other Mach.	15,278	3.9	11.2	38,979	7.5	15.3
Motor Vehicle and Equipment	1,530	.4	3.4	2,736	.5	3.3
Other Trans. Equipment	565	.2	6.9	3,248	.6	13.7
Other and Misc.	121,229	30.5	22.5	155,804	30.0	22.3
Transportation, Utilities and Comm.	24,048	6.1	13.8	35,056	6.7	14.4
Wholesale Trade	7,304	1.8	12.2	12,973	2.5	13.6
Retail Trade	54,531	13.8	15.6	76,577	14.7	16.6
Services	80,059	20.2	14.4	101,198	19.5	14.4
Others	5,694	1.4	17.5	6,394	1.2	15.4
TOTAL	396,257	100.0	16.9	520,006	100.0	16.9

Table 3-3 cont'd

Industry Group	1960 Number Employed	1960 Percent of Basin Total	1960 Percent of State Industry Total	1970 Number Employed	1970 Percent of Basin Total	1970 Percent of State Industry Total
Agriculture and Forestry	26,179	4.5	20.1	17,458	2.6	20.1
Mining	6,116	1.0	31.7	6,908	1.0	32.7
Contract Const.	28,599	4.9	16.1	34,595	5.1	16.9
Manufacturing	239,197	40.6	18.5	266,155 2/	39.0	18.3
Food and Kindred Products	12,130	2.1	14.8			
Electrical and Other Mach.	44,789	7.6	14.8			
Motor Vehicle and Equipment	11,177	1.9	10.1			
Other Trans. Equipment	7,765	1.3	14.1			
Other and Misc.	163,336	27.7	21.9			
Transportation, Utilities, and Comm.	36,427	6.2	15.9	40,951	6.0	16.3
Wholesale Trade	14,043	2.4	13.7	21,952	3.2	14.8
Retail Trade	85,822	14.6	16.9	105,614	15.5	16.7
Services	134,655	22.9	14.5	166,705	24.5	15.1
Other	17,546	3.0	13.3	21,354	3.1	12.4
TOTAL	588,584	100.0	16.7	681,692	100.0	16.8

1/ Includes 19 counties.
2/ Subcategories of manufacturing could not be obtained for 1970 in the same aggregations as used for earlier years.

Table 3-4
Rural Farm Work Force by Subarea, Muskingum River Economic Area
1959 - 1969 and Projected to 1980, 2000, and 2020

	Number of People in Rural Farm Work Force					
Subarea	1959 1/	1964 1/	1969 1/	1980	2000	2020
1	8,976	8,493	6,655	5,044	3,556	3,397
2	8,491	7,601	6,999	4,177	3,130	2,963
3	7,961	7,335	5,888	4,406	3,137	2,852
4	9,371	7,989	6,249	3,166	2,055	2,009
Muskingum River Basin	34,799	31,418	25,791	16,793	11,878	11,221
Percent Annual Change 2/	-2.0	-3.6	-3.2	-1.5	-.3	

1/ Sum of all farm operators plus hired workers employed 150 days or more.
2/ For indicated period.

for more than half of the new jobs in the basin over the next several years. A significant portion of the farming personnel who will seek industrial employment will be absorbed by these two counties.

Arkon, in Summit County, is the largest industrial area and accounts for most of that county's employment and income. Akron lies partly inside the Muskingum River Basin boundary but its economic influence is felt over a wide area both inside and outside the Basin.

3. Income

Median family income throughout the State of Ohio in 1970 was about $10,300; for rural farm families it was approximately $9,000. In the MREA the median income for all families ranged from $7,120 in Noble County to $11,178 in Summit County (Table 3-5). A large percentage of the families in the MREA are still in the poverty income range particularly in Subareas 3 and 4 (Table 3-5 and Map 3-3). The poverty income range as defined by the 1970 Census is $3,743 for a four member non-farm family, and $3,195 for a four member farm family. The cut off figure varies depending on such things as number and age of family members.2/

Subareas 3 and 4 had the highest percentage of families below poverty level (Table 3-5) and the lowest effective buying power per household. Of 464,776 families in the MREA there are 34,921 families below poverty level. At least 10,773 of this number were rural non-farm and 3,035 were rural farm residents (Table 3-6).

The 3,035 farm families in poverty in the MREA during 1970 were equally distributed among the four Subareas. Wayne and Holmes which are adjoining counties each had slightly over 400 farm families below poverty level (Map 3-4). All other counties had less than 200 each. Summit County was lowest with 24 farm families below poverty.

2/ For a detailed explanation of the poverty definition, see U.S. Bureau of the Census, Current Population Reports, Series p-23, No.28, Revision on Poverty Statistics, 1959 to 1968.

Table 3-5

Median Family Income and Number of Families Below Poverty
Muskingum River Economic Area, 1970

County and Subarea		1970			
		Median Family Income	Number of Families	Families Below Poverty	Percent Below Poverty
I	Medina	11,178	20,597	935	4.5
	Stark	10,249	95,798	5,520	5.8
	Summit	11,058	142,182	8,940	6.3
	Wayne	9,992	21,632	1,385	6.4
	TOTAL	-	280,209	16,780	6.0
II	Ashland	9,507	11,017	723	6.6
	Knox	8,788	10,724	689	8.1
	Licking	9,305	27,626	2,230	8.4
	Richland	10,117	33,360	2,372	7.1
	TOTAL	-	82,727	6,194	7.5
III	Carroll	8,635	5,654	637	11.3
	Coshocton	8,127	8,952	989	11.0
	Harrison	8,127	4,531	670	14.8
	Holmes	7,584	5,229	876	16.8
	Tuscarawas	8,544	20,420	1,734	8.5
	TOTAL	-	44,786	4,906	11.0
IV	Guernsey	7,990	9,585	1,169	12.2
	Morgan	7,171	3,322	544	16.4
	Muskingum	8,313	19,762	2,154	10.9
	Noble	7,120	6,679	534	19.9
	Perry	7,318	6,856	1,020	14.9
	Washington	8,568	14,741	1,620	11.0
	TOTAL	-	56,945	7,041	12.4
	MREA TOTAL	-	464,667	34,921	7.5

Source: Social and Economics Characteristics, Census of Population, 1970.

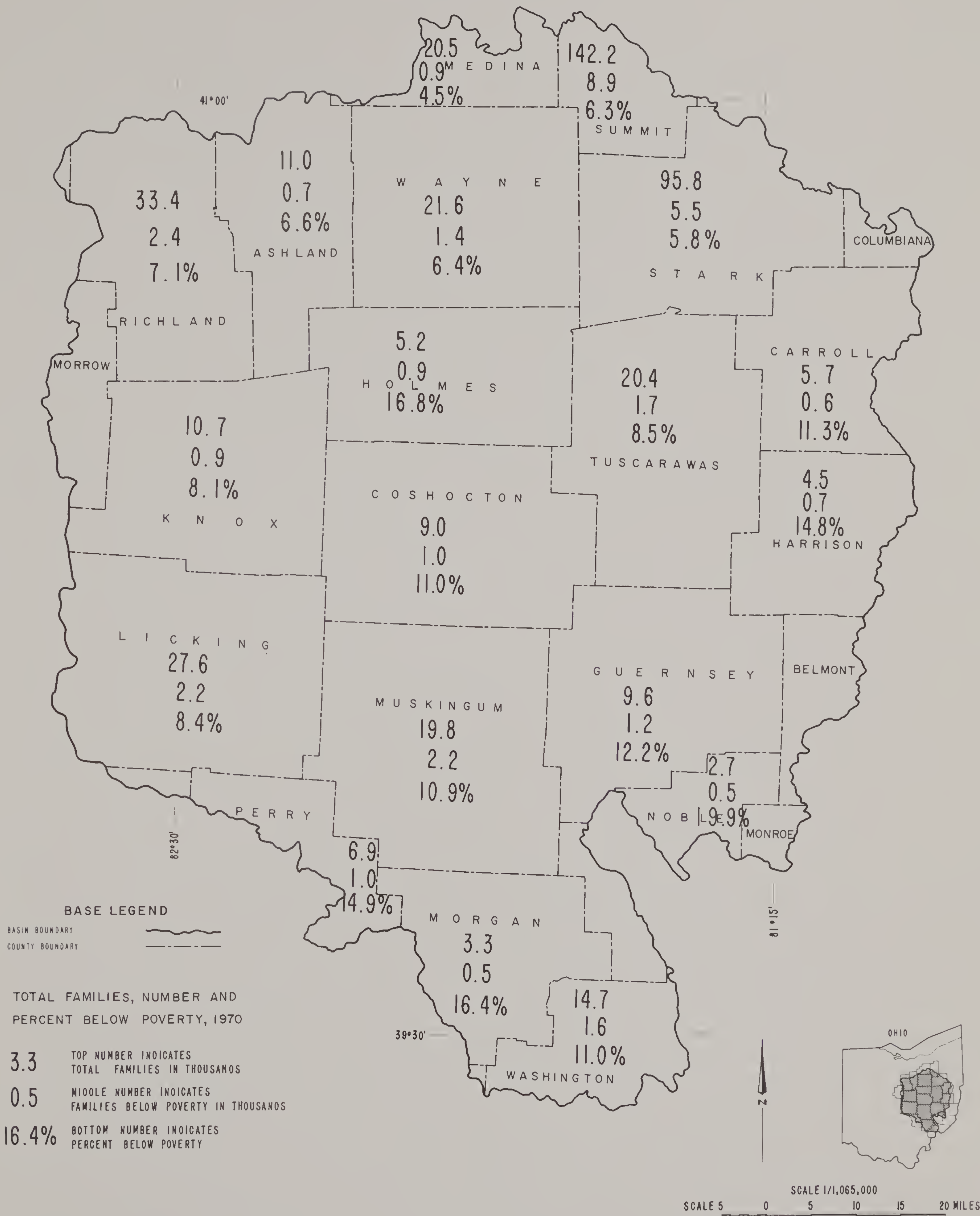
TABLE 3-6

Total Families and Number of Families Below Poverty Level
for Rural Farm and Rural Non-Farm Categories, 1970
MREA, Ohio

County and Subarea	Families	Rural Farm Families	Rural Farm Families Below Poverty	Rural Non-Farm Families	Rural Non-Farm Families Below Poverty
	Number				
Medina	20,597	1,840	119	8,599	366
Stark	95,798	2,921	197	22,371	1,028
Summit	142,182	970	24	12,216	500
Wayne	21,632	3,088	432	9,580	531
TOTAL	280,209	8,819	772	52,766	2,425
Ashland	11,017	1,884	157	3,401	251
Knox	10,724	1,365	122	5,716	509
Licking	27,626	2,122	195	10,687	829
Richland	33,360	2,092	150	7,907	443
TOTAL	82,727	7,463	624	27,711	2,032
Carroll	5,654	895	96	3,449	434
Coshocton	8,952	1,248	196	4,031	483
Harrison	4,531	474	66	3,260	502
Holmes	5,229	1,975	415	2,544	390
Tuscarawas	20,420	1,226	107	8,442	726
TOTAL	44,786	5,818	880	21,726	2,535
Guernsey	9,585	926	136	5,022	608
Morgan	3,322	635	114	2,687	430
Muskingum	19,762	1,152	134	9,369	737
Noble	2,679	582	125	2,097	409
Perry	6,856	1,030	150	3,853	667
Washington	14,741	1,030	100	7,853	930
TOTAL	56,945	5,355	759	30,881	3,781

MAP 3-3

TOTAL FAMILIES BELOW POVERTY, 1970
NUMBER AND PERCENT
MUSKINGUM RIVER BASIN
OHIO



SOURCE:
FAMILY OF MAPS SCS DRAWING NO. 5,R-32,783 (1-30-74), ECONOMIC RESEARCH SERVICE, AND INFORMATION FROM FIELD TECHNICIANS.
TRANSVERSE MERCATOR PROJECTION.

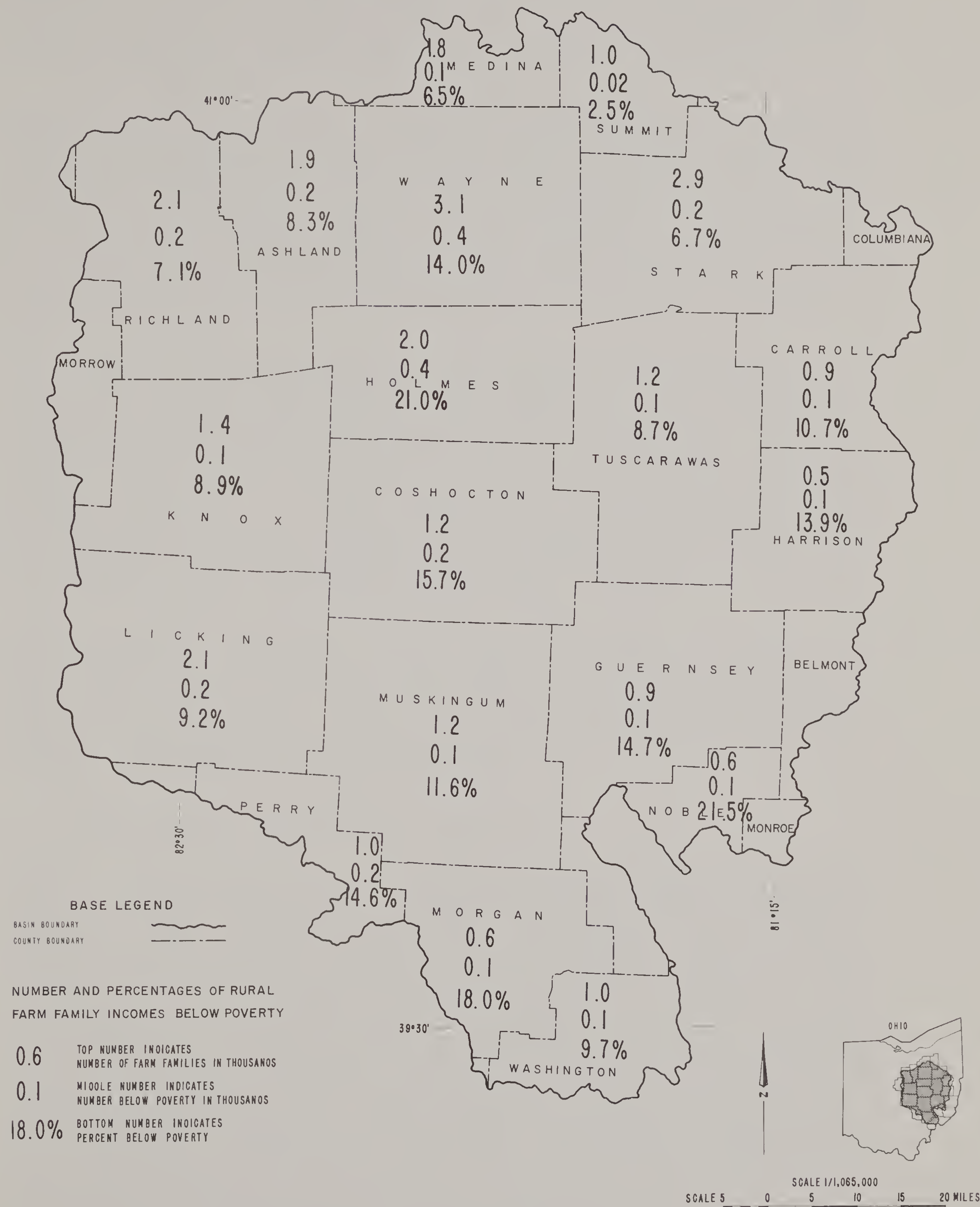
7-12-74
5,N-34,368

USDA-SCS-LINCOLN, NEBR. 1974

U. S. DEPARTMENT OF AGRICULTURE

MAP 3-4

RURAL FARM FAMILY INCOMES BELOW POVERTY
NUMBER AND PERCENT
MUSKINGUM RIVER BASIN
OHIO



SOURCE:
FAMILY OF MAPS SCS DRAWING NO. 5,R-32,783 (1-30-74), ECONOMIC RESEARCH SERVICE, AND INFORMATION FROM FIELD TECHNICIANS.
TRANSVERSE MERCATOR PROJECTION.

7-12-74
5,N-34,369

USDA-SCS-LINCOLN, NEBR. 1974

Subarea 1 with 39.7 percent of the rural non-farm families in the MREA, had 22.5 percent of those with below poverty incomes. Subarea 4 had the largest number in this category with 3,781 (Table 3-6 and Map 3-5).

Since personal income was not available by county, effective buying income published by "Sales Management Survey of Buying Power" is used as a proxy (Table 3-7 and Map 3-6). Stark and Summit Counties on the northern edge of the MREA region had 9 percent of Ohio's buying power in 1967 and approximately the same in 1970. They accounted for almost 56 percent of the MREA's effective buying income.

The MREA had approximately 16 percent of Ohio's population in 1970, and about 16 percent of the State's effective buying income (Table 3-7). Within the MREA the buying income was not so evenly distributed. Morgan, Noble, and Perry Counties had a "household effective buying income" of less than 70 percent of the State average while most counties in the MREA constituted about 85 percent of the State's average. Subarea 1 counties were all above 93 percent of the State average.

Manufacturing provides the major source of income for both the State of Ohio and MREA. In 1966, however, 33 percent of personal income was from manufacturing (Table 3-8). During 1972 a mere one percent of Ohio's personal income was supplied by farming.3/

4. Urban Centers and Their Influence

Urban concentrations of people and economic activities are a mixed blessing. Concentrations arise primarily because they promote economic efficiency and communication among several interrelated producing and consuming activities. Transportation costs of assembling raw materials and number of workers needed at factory sites is reduced. Workers find it easier to transfer between jobs. However, workers living in the area must contend with congestion and other problems resulting from such concentrated centers of economic activity. Land prices are higher. There is a greater population density and

---

3/ Survey of Current Business, April 1972.

TABLE 3-7

Estimated Total and Per Household Effective Buying Income
By State, Subarea, and County, Muskingum River Basin, Ohio
1967 and 1970 1/

Area	County Total Effective Buying Income (In Thousand Dollars)		Per Household Pct. of State		Per Household Dollars	
	1967	1970	1967	1970	1967	1970
County						
Medina	200,830	243,001	97.9	96.7	9,006	10,474
Stark	991,934	1,208,894	98.4	86.1	9,059	10,413
Summit	1,645,046	1,978,069	105.0	105.0	9,665	11,349
Wayne	203,722	257,193	93.8	93.1	8,632	10,086
Subarea 1 Total	3,041,532	3,687,517				
Ashland	103,745	134,838	87.4	92.2	8,042	9,988
Knox	96,058	118,773	83.5	83.7	7,685	9,067
Licking	264,587	317,146	89.8	87.4	8,268	9,467
Richland	360,093	428,327	98.0	98.9	9,025	10,708
Subarea 2 Total	824,483	999,084				
Carroll	44,367	51,029	80.3	77.4	7,395	8,387
Coshocton	74,784	89,452	75.2	73.7	6,924	7,987
Harrison	35,258	43,316	72.3	71.0	6,652	7,694
Holmes	37,240	47,744	74.9	74.7	6,896	8,092
Tuscarawas	185,234	217,709	82.2	80.7	7,561	8,743
Subarea 3 Total	376,883	449,250				
Guernsey	81,863	94,789	77.4	72.9	7,119	7,899
Morgan	25,207	28,133	68.5	68.4	6,302	7,403
Muskingum	188,688	213,775	81.7	79.6	7,517	8,620
Noble	19,645	23,875	64.7	64.8	5,953	7,022
Perry	50,442	59,695	68.5	66.4	6,305	7,192
Washington	117,294	146,179	74.1	75.8	6,819	8,212
Subarea 4 Total	483,139	566,446				
Muskingum Basin Total	4,696,037	5,702,297				
State of Ohio Total	29,166,253	35,944,478	100.0	100.0	9,205	10,835

1/ Source: C 1967 and 1971, Sales Management Survey of Buying Power; further Reproduction is forbidden.

TABLE 3-8

Personal Income by Major Sources
State of Ohio, 1950, 1960 and 1966

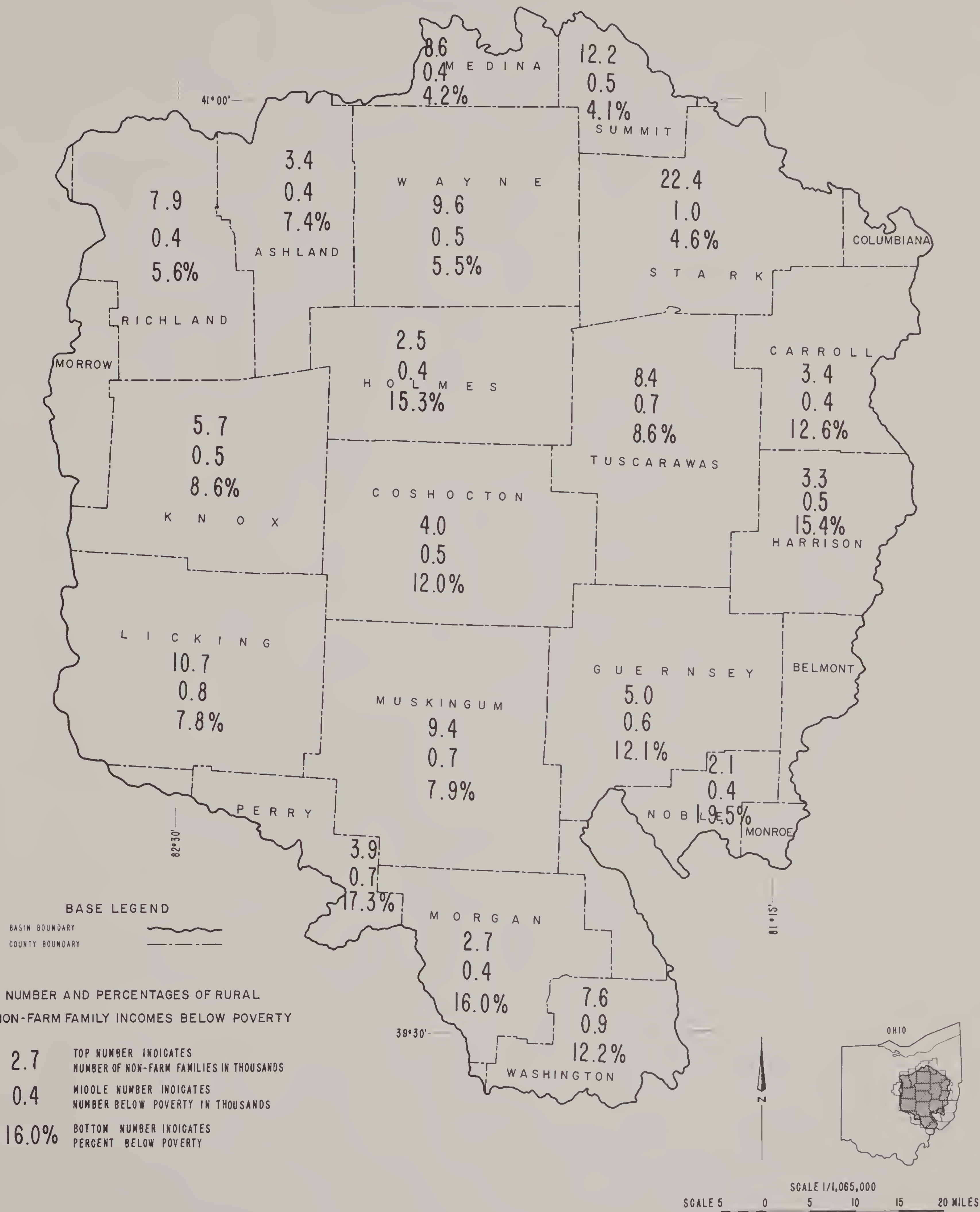
	1950		1960		1966	
	Million Dollars	Per-cent	Million Dollars	Per-cent	Million Dollars	Per-cent
Wages & Salaries	8,852	68.7	16,025	70.5	22,206	69.5
Farms	66	.5	63	.3	43	.1
Mining	91	.7	112	.5	141	.4
Contract Construction	420	3.3	788	3.5	1,261	4.0
Manufacturing	4,255	33.0	7,339	32.3	10,302	32.5
Wholesale and Retail Trade	1,482	11.5	2,663	11.7	3,315	8.7
Finance, Insurance and R.E.	254	2.0	554	2.4	749	2.3
Trans. Comm. and Public Utilities	604	4.7	882	3.9	1,508	4.8
Services	628	4.9	1,286	5.7	2,026	6.4
Government	828	6.4	1,891	8.3	2,837	9.0
Other Industry	12	.1	25	.1	26	.1
Other Labor Income	277	2.1	796	3.5	1,414	4.5
Proprietor's Income	1,602	12.4	2,053	9.0	2,685	8.5
Property Income	1,602	12.4	2,841	12.5	4,203	13.3
Transfer Payments	720	5.6	1,528	6.7	2,185	6.9
Less: Social Sec. Contrib.	-163	-1.3	-521	-2.3	-1,023	-3.2
TOTAL, All sources1/	12,891	100.0	22,722	100.0	31,670	100.0

1/ Items do not sum to totals due to rounding.

Source: Ohio Statistical Abstract, 1969.

MAP 3-5

RURAL NON-FARM FAMILY INCOMES BELOW POVERTY
NUMBER AND PERCENT
MUSKINGUM RIVER BASIN
OHIO



SOURCE:
FAMILY OF MAPS SCS DRAWING NO. 5,R-32,783 (1-30-74), ECONOMIC RESEARCH SERVICE, AND INFORMATION FROM FIELD TECHNICIANS.
TRANSVERSE MERCATOR PROJECTION.

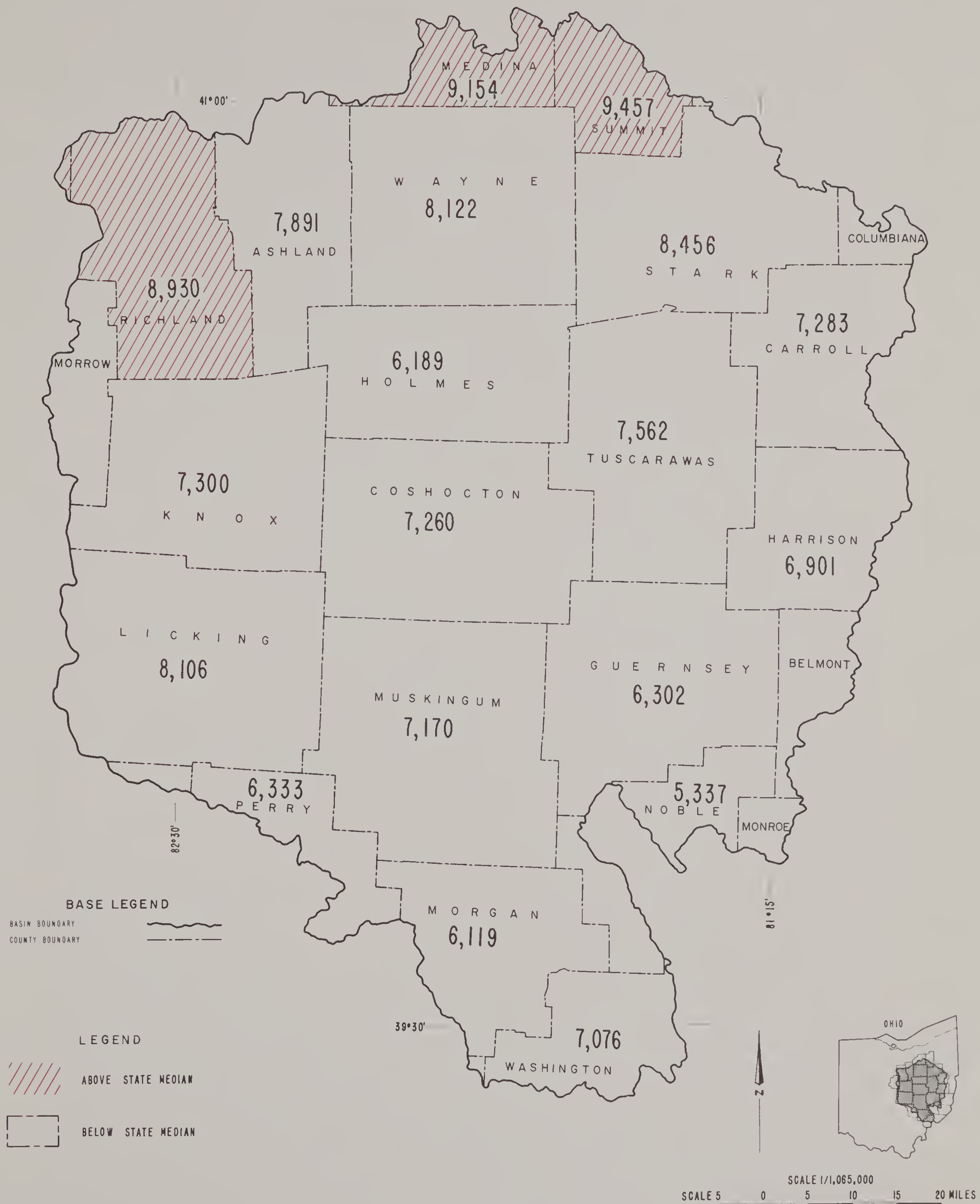
7-12-74
5,N-34,370

USDA-SCS-LINCOLN, NEBR. 1974

U. S. DEPARTMENT OF AGRICULTURE

MAP 3-6

BUYING INCOME PER HOUSEHOLD BY COUNTIES
STATE MEDIAN - $8,878
MUSKINGUM RIVER BASIN
OHIO



SOURCE:
FAMILY OF MAPS SCS DRAWING NO. S,R-32,783 (1-30-74), ECONOMIC RESEARCH SERVICE, AND INFORMATION FROM FIELD TECHNICIANS.
TRANSVERSE MERCATOR PROJECTION.

7-12-74
S,N-34,371

USDA-SCS-LINCOLN, NEBR. 1974

U. S. DEPARTMENT OF AGRICULTURE

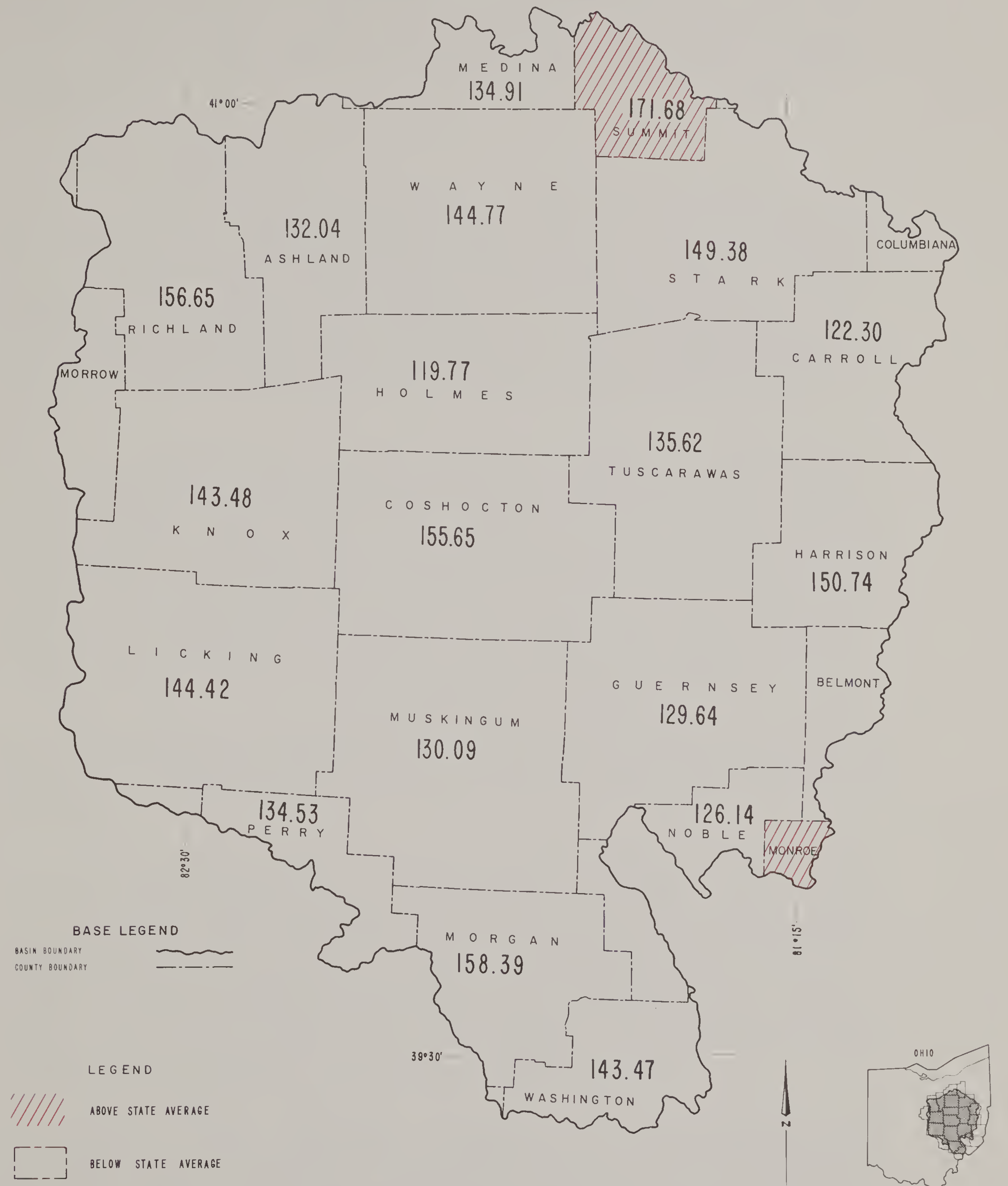
MAP 3-7

AVERAGE WEEKLY EARNINGS BY COUNTIES

STATE AVERAGE - $159.77

MUSKINGUM RIVER BASIN

OHIO



SOURCE:
FAMILY OF MAPS SCS DRAWING NO. S,R-32,783 (1-30-74), ECONOMIC RESEARCH SERVICE, AND INFORMATION FROM FIELD TECHNICIANS.
TRANSVERSE MERCATOR PROJECTION.

7-12-74
S,N-34,372

USDA-SCS-LINCOLN, NEBR. 1974

less open space to enjoy. There is more noise, more air and water pollution to detract from the quality of life. At the same time, however, more products are manufactured at a lower cost as a result of these urban concentrations.

5. Urban Centers

The major urban centers located within the 19 county area are Akron in Summit County and Canton in Stark County. Both are in the Northeast section of the area. Their centers are within 25 miles of each other and the peripheral built-up areas about 10 miles apart. The area between them is characterized by many small built-up zones of 10 or more residences affecting approximately 20 acres.

Both are industrial centers closely linked to the Youngstown-Warren and the Cleveland Standard Metropolitan Statistical Area. The City of Canton had a population of 113,631 and an area of 14.3 square miles in 1960. It had decreased to 110,053 by 1970. In 1960 Akron had 290,351 people and an area of 53.9 square miles. Its population decreased to 275,425 by 1970. In 1960, the median family income was $5,726 for Canton and $6,466 for Akron.

In 1960, Canton had a manufacturing employment of 18,070 and a total employment force of 41,640. Akron had 48,359 employed in manufacturing and a total employment force of 109,936.

The Akron SMSA which includes all of Summit and Portage Counties had a population of 513,569 in 1960. By 1970, it had increased by 32 percent to 679,239. The Canton SMSA (including all of Stark County) population was 340,345 in 1960, and by 1970 had increased nine percent to 372,210. Median family income in 1960 was $6,161 for the Canton SMSA and $6,735 for the Akron SMSA. By 1970 these had increased to $9,007 and $9,213 respectively.

The Akron SMSA includes Portage County which is not included in the Muskingum Study Area. Total employment in the Akron SMSA in 1970 was 260,063, a 7.5 percent increase over 1960. Slightly less than one percent of the employment was in farming and forestry, and almost 40

percent was in manufacturing. Employment in the two-county Akron SMSA is equivalent to about 38 percent of the total MREA employment.

The Canton SMSA includes only Stark County. In 1960 its total employment was 120,895, and by 1970 had increased to 141,260.

6. Land Use

Land available for agriculture in the MREA was considered to be the acreage shown in the 1967 Conservation Needs Inventory for cropland and pasture (Table 3-9 and 3-10). Total cropland and pasture land was 3,115,701 acres in 1966 with about 2 million in cropland and 1 million in pasture land.

The northern and western portions of the study area have larger percentages of cropland than do the southern and eastern portions. There is a considerable amount of flat cornbelt land in the western counties. Much of the topography in the southern and eastern counties is steep sloping and not well suited to row cropping. Much of that area is in forests and pastures. Figure 3-3 shows the portion in each land use according to the 1967 Conservation Needs Inventory.

Figure 3-4 shows crop and pasture land available in 1980 in each Soil Resource Group (SRG) after reducing it for projected urban land conversions. Each column indicates the approximate acreage represented by the typical land capability unit shown at the bottom (e.g., the land capability unit representative of SRG 19 is LCU 2W608). The columns also indicate amount of wet land in each SRG.

Forest land use is 34.3 percent or about 2.0 million acres in the MREA. Of this, 77 percent is commercial forest found in Subareas III and IV with 43.6 and 40.5 percent respectively (Table 3-10). The largest classification of forest land is "seedlings and saplings" comprising 52 percent of the forested land. Saw timber is second at 25 percent with poletimber comprising 10 percent of the total. Table 3-11 shows forest acreage by SRG and the production potential of each SRG under no management and good management headings.

TABLE 3-9

Major Land Use by Subarea
Muskingum River Economic Area, 1967

Land Use	Subareas 1	2	3	4	Muskingum River Economic Area
Cropland	571,242	675,198	433,710	384,783	2,064,933
Pasture	96,021	225,604	272,177	456,966	1,050,768
Total Agriculture Land	667,263	900,802	705,887	841,749	3,115,701
Forest	208,215	276,916	650,900	948,289	2,084,320
Urban	255,199	110,467	58,538	98.870	523,074
Other	126,834	77,255	79,055	67,177	350,321
Total Land Area*	1,257,511	1,365,440	1,449,380	1,956,085	6,073,416
Water $\geq$ 40 Acres*	7,488	4,928	12,288	7,488	32,192
Water $\leq$ 40 Acres*	4,121	1,792	6,932	4,427	17,272
Total Water Area*	11,609	6,720	19,220	11,915	49,464
Total Geographic Area	1,269,120	1,372,160	1,513,600	1,968,000	6,122,880

* These items are held constant in all projection years in these tables.
Source: 1971 Ohio Conservation Needs Inventory and Bureau of the Census Area Measurement Reports.

TABLE 3-9A

Projected Major Land Use by Subarea
Muskingum River Economic Area

Land Use	Subarea 1	2	3	4	Muskingum R. Economic Area
Year 1980					
Cropland	531,905	668,443	420,287	380,050	2,000,685
Pasture	91,943	224,350	273,503	454,003	1,043,799
Total Ag. Land	623,848	892,793	693,790	834,053	3,044,484
Forest 1/	195,592	274,648	643,349	951,565	2,065,154
Urban	321,799	121,407	79,639	103,682	626,527
Other	116,272	76,592	77,602	66,785	337,251
Total Land Area	1,257,511	1,365,440	1,494,380	1,956,805	6,073,416
Year 2000					
Cropland	475,170	646,829	404,540	370,212	1,896,751
Pasture	86,073	218,920	277,284	447,809	1,030,086
Total Ag. Land	561,243	865,749	681,824	818,021	2,926,837
Forest	177,942	268,332	637,955	954,152	2,038,381
Urban	416,801	157,199	98,599	118,180	790,779
Other	101,525	74,160	76,002	65,732	317,419
Total Land Area	1,257,511	1,365,440	1,494,380	1,956,085	6,073,416
Year 2020					
Cropland	399,750	615,771	386,397	359,558	1,761,476
Pasture	77,857	211,174	280,026	440,825	1,009,882
Total Ag. Land	477,607	826,945	666,423	800,383	2,771,358
Forest	153,650	259,301	630,510	955,848	1,999,309
Urban	544,200	208,500	123,196	135,297	1,011,193
Other	82,054	70,694	74,251	64,557	291,556
Total Land Area	1,257,511	1,365,440	1,494,380	1,956,085	6,073,416

1/ Includes Federal forest land based on 1969 holdings.

TABLE 3-10

Percent Distribution of Land by Land Use,
Muskingum River Basin (19 Counties), 1965

Economic Areas	Cropland	Pasture	Total Ag. Land	Forest	Urban	Other	Total Land Area
Area I	45.4	7.6	(53.0)	16.6	20.3	10.1	100.0
II	49.5	16.5	(66.0)	20.3	8.1	5.6	100.0
III	29.0	18.2	(47.2)	43.6	3.9	5.3	100.0
IV	19.7	23.4	(43.1)	40.5	5.0	3.4	100.0
Muskingum Basin	34.0	17.3	(51.3)	34.3	8.6	5.8	100.0

Table 3-11
Forest Acreage by SRG and Production Potential
Under No Management and With Management
Muskingum River Economic Area

	No Management			Good Management		
SRG	Acres Per Group	MAI BF/A	Total Increment In Basin M.B.F.3/	Site Index	MAI1/ BF/A	Total Increment In Basin M.B.F.4/
1	58,955	346	20,398	85	508	29,949
2	5,707	309	1,763	80	454	2,591
3	36,135	346	12,503	85	508	18,357
4	5,618	309	1,736	80	454	2,551
5	3,753	309	1,160	80	454	1,704
6	32,334	309	9,991	80	454	14,680
7	73,991	239	17,684	70	351	25,971
8	57,565	309	17,788	80	454	26,135
9	3,075	0	--	--	-	--
10	19,020	239	4,546	70	351	6,676
11	8,109	239	1,938	70	351	2,846
12	47,413	239	11,332	70	351	16,642
13	13,479	239	3,221	70	351	4,731
14	26,994	239	6,452	70	351	9,475
15	24,153	239	5,773	70	351	8,478
16	25,795	309	7,971	80	454	11,711
17	9,424	309	2,912	80	454	4,278
18	25,935	309	8,014	80	454	11,774
19	13,959	309	4,313	80	454	6,337
20	97,794	309	30,218	80	454	44,398
21	382,331	239	91,377	70	351	134,198
22	738,605	239	176,527	70	351	259,250
23	255,230	239	61,000	70	351	89,586
24	74,304	DG-	--	--	-	--
25	44,643	346	15,446	85	508	22,679
TOTAL	2,084,320	--	514,063	--	-	754,997

1/ Mean annual increment (MAI) is based on 80-year stands thinned every 10 years to age 60. Average Basin production is 247 BF/A year "without good management" and 362 BF/A/yr. with "good management." A 47 percent increase was assumed with good management by 2020.

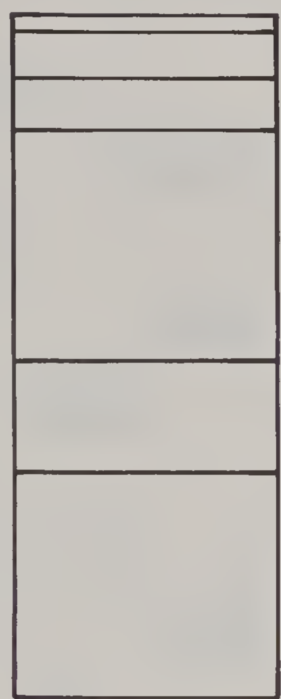
2/ BF/A - Board feet per acre.

3/ M.B.F. - 1000 board feet.

4/ Annual increment of growth possible by 2020 with good management on all acreage.

Figure 3-3

MAJOR LAND USE IN THE MUSKINGUM RIVER BASIN
1966 (19 counties)



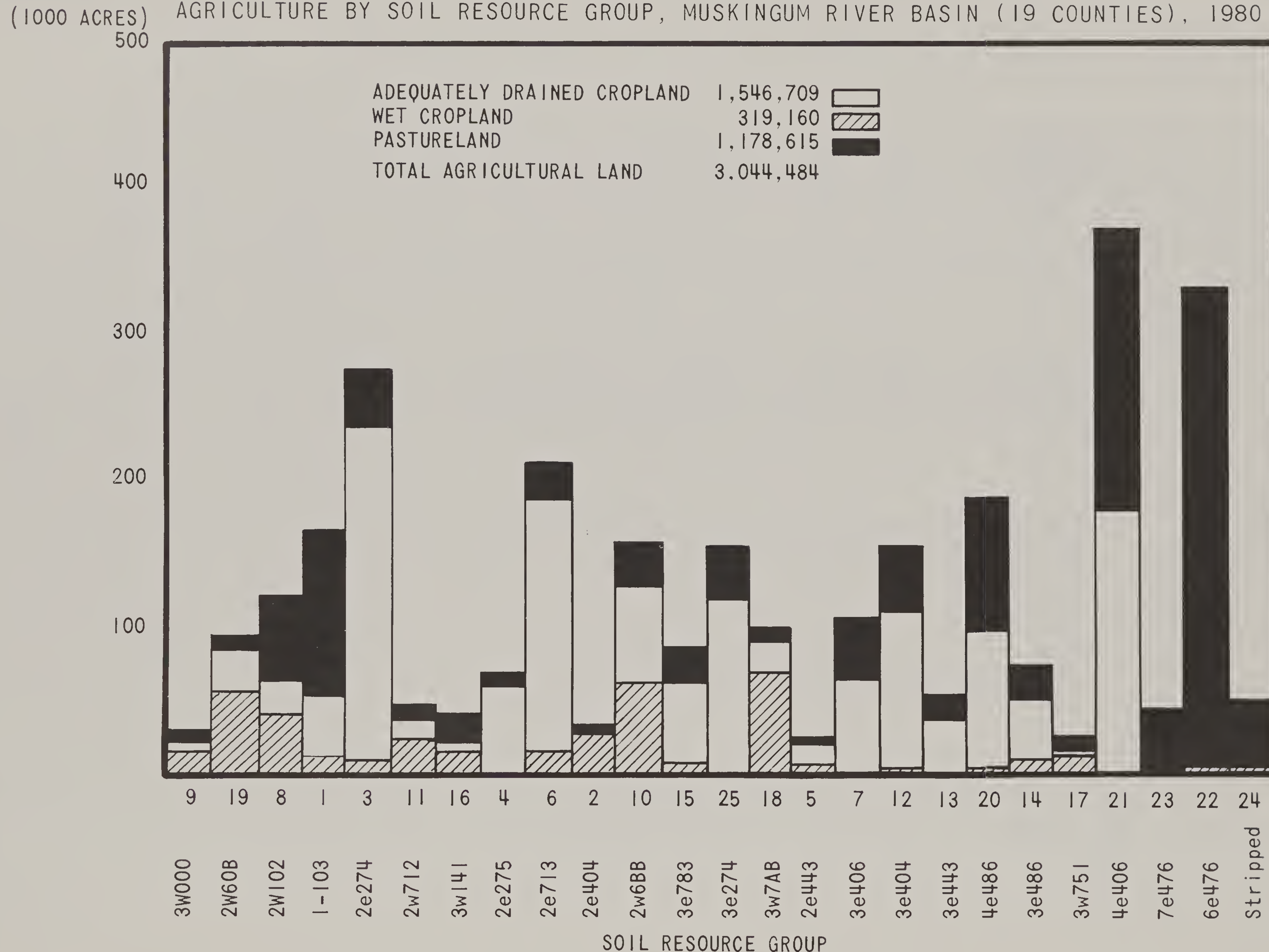
PERCENT	USE	ACRES
*	Water	49,464
5.8	Other	350,321
8.6	Urban	523,074
34.3	Forest	2,084,320
17.3	Pasture	1,050,768
34.0	Cropland	2,064,933

Total geographic area: 6,122,880 acres or 9,567 square miles.

* Water not included in percentage computations.

Figure 3-4

ACREAGE OF CROP AND PASTURE LAND PROJECTED TO BE AVAILABLE FOR AGRICULTURE BY SOIL RESOURCE GROUP, MUSKINGUM RIVER BASIN (19 COUNTIES), 1980



Stripmining is an important use of land in 16 MREA counties. Acreage is projected to increase from 160,641 in 1966 to about 226,000, 318,000 and 410,000 in 1980, 2000, and 2020 respectively (Table 3-12 and Figure 3-5). All of these acreages are assumed to be reclaimed as either forest or pasture. In 14 counties 25 percent is assumed to be reclaimed as pasture and 75 percent as forest. In Harrison and Wayne counties, 50 percent are expected to go into each use. Table 3-12 shows by subareas the acreage expected to change from crop and pasture to stripmining by subareas. A transfer from agriculture to forest through the reclamation processes is implied.

Urbanization is another category expected to take a significant portion of the agricultural land out of production (Table 3-12). Urban projections are assumed to cover all nonagricultural uses other than stripmining, e.g., highways and airports. Total land expected to change from rural to urban is about 627,000, 791,000 and 1,011,000 acres by 1980, 2000, and 2020 respectively. Percentage of land in urban use is expected to increase from 8.6 to 16.6 between 1966 and 2020. The largest is expected to occur in Subarea 1 which is estimated to lose about 66,000, 161,000, and 289,000 acres by 1980, 2000, and 2020 respectively. Each Soil Resource Group is assumed to lose land to urban use in the same proportion as it is now affected by urban and built up areas. The acreage supplied in each SRG comes from the four land use categories in the same proportion that each category comprises the total SRG.

7. Transportation

Transportation facilities affect cost of moving raw materials, finished products, workers, and tourists. Without good facilities a producing center is at a disadvantage compared to competing producing centers which do have good facilities. The availability of interstate highways, rail lines, or barge facilities will play a significant role in development of new producing centers and in the ability of existing centers to maintain a competitive position in their major industries.

Table 3-12
Present and Projected Conversion of Land to Stripmining and Urban Uses, Muskingum River Basin, 1966, 1980, 2000, and 2020

Use	Year	Crop	Pasture	Forest	Other	Projected Acreage 3/	Total Acreage 2/
		1000 Acres					
Stripmining	1966 1/						160.6
	1980	11.1	16.7	36.7.	1.3	64.9	225.5
	2000	24.5	40.6	89.2	3.2	157.5	318.2
	2020	38.9	64.5	141.7	5.1	249.2	409.8
Urban	1966						523.1
	1980	54.1	11.0	26.6	11.8	103.5	626.5
	2000	143.7	30.4	64.0	29.7	267.7	790.8
	2020	264.9	56.2	113.4	53.7	488.1	1,011.2

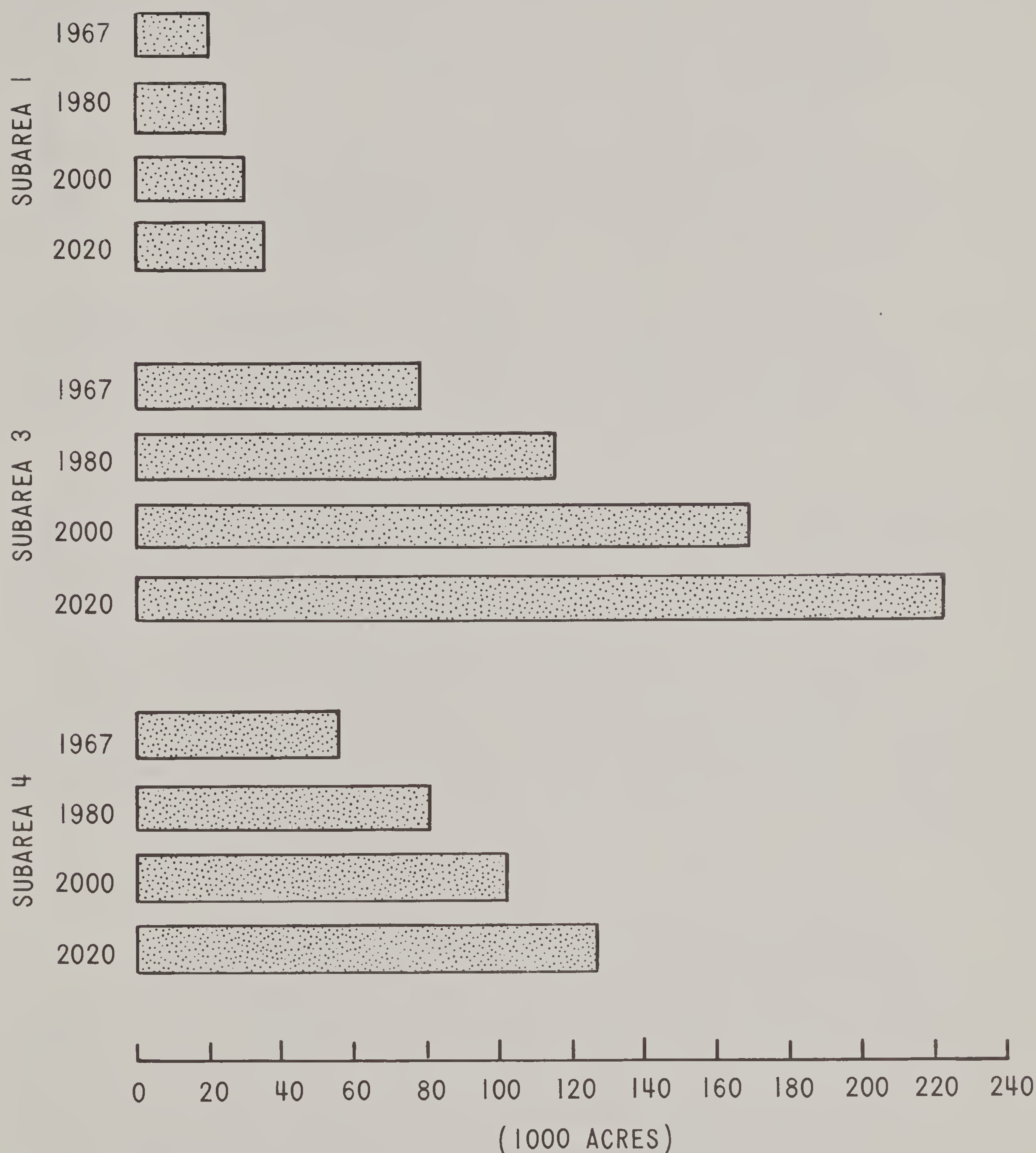
1/ Existing acreage according to CNI. Projections based on trends from 1954-1966 as determined from Ohio Department of Natural Resources data.

2/ Detail may not add to total due to rounding.

3/ About 75 percent of this acreage was assumed to be reclaimed as forest with the remaining 25 percent reclaimed as pasture. Therefore the acreage shown as lost from forest and pasture land were partially replaced. Only the net loss is reflected in the projected forest and pasture acreage in Table 3-9A.

Figure 3-5

STRIPMINING ACREAGE
MUSKINGUM RIVER ECONOMIC AREA
1967 AND PROJECTED 1/



1/ SUBAREA 2 HAD NO STRIPMINING

Three of the four interstate highways that cross parts of the MREA area provide direct access to the Cleveland-Akron-Youngstown complex (Map 3-8). Eleven Federal highways and 128 State routes cover the area to supplement the Interstate System. Counties not having access to Interstate highways include Coshocton, Knox, Holmes, Morgan, Harrison, and Carroll. Many of the more heavily populated areas of these counties are served by four lanes expressways, however.

Four of the six railroads serving the area have main east-west routes between Cincinnati, Chicago and St. Louis on the west, and Buffalo and Pittsburgh on the east. Many branch lines reach into every MREA county (Map 3-8).

Every county in MREA now has or has planned an airport with a runway of at least 3,000 feet length (Map 3-8). At the present time Akron in Summit County and Mansfield in Richland County are the only cities served by major airlines.

Counties which have an abundance of good industrial sites along the Ohio River in addition to good rail and highway transportation are likely to obtain a large share of new industry in the future. Washington County, for example, has direct access to barge transportation which gives it an advantage for shipping heavy goods at low transportation costs. Agricultural production may decline in counties experiencing rapid industrial growth due to the increase in off-farm job opportunities. This is most probable where topography and soils limit agricultural capability.

C. Agriculture and Related Economic Activity

Historical and projected crop and livestock production is reported in this section for the 19 counties of the MREA. Projections of both crop and livestock production for the MREA Region are derived from a nationally consistent set of agricultural projections. These projections were prepared by the Economic Research Service in 1967 and are based on Series C population projections. 4/ National

---

4/ See Preliminary Projections of Economic Activity in the Agricultural Forestry and Related Economic Sectors of the United States and its Water Resource Regions 1980, 2000, and 2020. Page iii.

TRANSPORTATION MAP

MUSKINGUM RIVER BASIN

OHIO

MAP 3-8

SOURCE: FAMILY OF MAPS SCS DRAWING NO. 5-R-32-383 (1-30-74) AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION

USDA-SCS-LINCOLN, NEBR. 1974

9-12-74
5,P-34,373

requirements for both domestic and export purposes of food and fiber production were allocated to major river basins on the basis of past production patterns.

Data were not adequate to allow allocations which would anticipate long term shifts in comparative advantage among the producing areas. Allocations of the Ohio River Basin projections were made to the MREA Region on the basis of historical shares of production. The share of commodities produced historically by MREA were computed for 1954, 1959, and 1964. Giving consideration to the trend during these years a percentage share for 1980, 2000, and 2020 was selected and applied to the Ohio River Basin projection. The result is assumed to be a projected normal production level consistent with national analysis and suitable for comparison of this study with similar studies in other regions. This projected level of demand should not necessarily be taken as a prediction of future production in the region nor as a production goal.

Given this assumed production (or demand level) and the agricultural resources as measured by the 1967 Conservation Needs Inventory for Ohio, a linear programming model was used to allocate production among the MREA soils in the least cost pattern for the projection years 1980, 2000, 2020. The model utilized producing activities for 25 soil resource groups which were based on differences in yields and costs of production.

1. Major Crops: Acreage, Production and Value

Corn for grain has historically been the major income producing crop grown in MREA (Table 3-13). Almost 60 percent of the corn is produced in the northern and western counties (Subarea 1 and 2) of the MREA. Hay is the largest land using crop with almost 500,000 acres devoted to hay in 1964. It is well distributed throughout the MREA Region. The trend has been toward more alfalfa and less clover-timothy and other types of hay, according to the Census of Agriculture. Other major crops include soybeans, oats, silage, and pasture.

Value of all crops based on 1964 prices was projected to rise from 94,688,000 dollars in 1964 to 196,940,000 in

Corn is the major crop in the basin.

The dairy industry is the largest source of farm income in the basin.

TABLE 3-13

Current and Projected Acreage,
Production and Value of the Major Crops Produced in the Muskingum River Economic Area[1/]

Crop	Unit	1964	1969	1980	2000	2020
		1,000 Units				
Corn	Acres	396	312	360	395	441
	Bushels	24,788	26,721	40,163	51,125	62,996
	Dollars	26,523	28,591	42,974	54,704	67,406
Oats, Barley and Rye	Acres	130	126	144	125	165
	Bushels	7,096	7,560	10,300	9,919	12,889
	Dollars	4,612	4,914	6,695	6,447	8,378
Wheat	Acres	173	114	193	200	185
	Bushels	4,930	3,590	6,854	7,813	8,928
	Dollars	7,444	5,421	10,349	11,798	13,481
Soybeans	Acres	59	83	71	76	80
	Bushels	1,274	2,425	2,738	3,355	4,001
	Dollars	3,172	6,038	6,818	8,354	9,962
All Silage	Acres	76	56	68	97	125
	Bushels	785	728	1,216	1,946	2,816
	Dollars	6,985	6,479	10,822	17,322	25,064
All Hay	Acres	497	433	415	362	290
	Bushels	1,005	917	1,402	1,484	1,484
	Dollars	22,603	20,633	31,545	33,395	33,397
All Permanent Pasture	Acres	906	786	633	616	644
	Bushels	906	943	994	1,151	1,272
	Dollars	18,120	18,860	19,880	23,010	25,444

TABLE 3-13 Cont'd. Sheet 2 of 2

Crop	Unit	1964	1969	1980	2000	2020
		1,000 Units				
Fruits	Acres	8.8	8.6	11.0	14.3	17.2
	Tons	21.2	21.5	29.8	43.7	59.4
	Dollars	2,094	2,129	2,951	4,324	5,881
Vegetables (non-irrigated)	Acres	5.5	5.9	4.0	3.6	2.0
	Tons	28.3	30.0	19.3	19.5	11.8
	Dollars	1,344	1,422	916	923	560
Vegetables (irrigated)	Acres	(Included in non-irrigated)	(Included in non-irrigated)	4.0	5.4	7.9
	Tons			27.0	41.0	66.0
	Dollars			1,279	1,918	3,881
Irish Potatoes (non-irrigated)	Acres	3.8	3.7	2.6	2.8	3.0
	Tons	38.0	37.0	30.0	37.0	43.0
	Dollars	1,791	1,732	1,386	1,726	2,036
Irish Potatoes (irrigated)	Acres	(included in non-irrigated)	(Included in non-irrigated)	1.1	1.5	2.0
	Tons			21.0	33.0	48.0
	Dollars			981	1,534	2,242
TOTAL 2/	Acres	2,257	1,928	1,906	1,900	1,962
	Dollars	94,688	96,219	135,615	163,729	196,940

1/ All production valued at 1964 standardized prices.

2/ Totals not precise due to rounding.

2020 (Table 3-13). This value includes all pasture valued at dry hay prices as well as all other products produced on the farm. It is higher than the value reported by the Census because the Census reports only the value of crops sold off the farm.

Feed grains produced in MREA are expected to be more than adequate for livestock produced in the region. There may be as much as 10 million bushels of corn for export outside MREA in 1980 unless cattle and hog feeding expands significantly in the area.

2. Major Livestock Enterprises

The value of all livestock products in the MREA is projected to rise from 124,140,000 dollars in 1964 to 309,981,000 dollars in 2020 (Table 3-14). Sale of milk products is the largest single component of this total. Almost 40 percent of the milk will be produced in Subarea 1, i.e., the northern counties near the large population centers. Beef and veal production is the second most important livestock product. This product is fairly well distributed throughout the MREA Region but most feeding is done in the northern and western counties where the bulk of the feed grain is produced.

3. Agricultural Employment

The number of people in the rural farm work force is projected to decline from 31,418 in 1964 to 11,221 in 2020 if the historical share of projected demands is produced in the MREA (Table 3-15). The decline is expected to proceed rapidly until the period 1980 to 2000 and level off after 2000. Between 1964 and 1980 the rural farm work force will decrease by almost 50 percent. Between 2000 and 2020 the decline may be as small as five percent. Workers in the northern and western parts of the MREA are more fully employed in agriculture than are workers in the southern part.

4. Rural Farm Income

Value of all farm commodities produced in MREA is projected to increase from 238,102,000 dollars in 1969 to about 534 million dollars in 2020 (Table 3-16). Cash

TABLE 3-14

Current and Projected Production and Value of Livestock Sold
From Farms in the Muskingum River Basin (19 counties) 1/

Crop		1964	1969 2/	1980	2000	2020
Beef and	1000 lbs.	143,680	149,946	193,579	268,902	355,556
Veal	1000 dollars	27,874	29,089	39,992	55,505	73,387
Pork Sold	1000 lbs.	93,381	113,509	148,088	194,580	253,795
	1000 dollars	16,818	20,432	26,152	34,363	44,820
Lamb and	1000 lbs.	14,414	14,962	15,881	22,342	30,954
Mutton	1000 dollars	2,630	2,738	2,813	3,959	5,405
Milk	1000 lbs.	1,337,806	1,298,504	1,914,245	2,524,407	3,313,664
	1000 dollars	58,863	57,134	84,227	111,074	145,801
Farm	1000 lbs.	8,237	13,418	11,989	15,652	20,201
Chickens	1000 dollars	906	1,476	1,187	1,550	2,002
Eggs Sold	1000 lbs.	38,929	41,405	48,443	63,549	75,384
	1000 dollars	12,574	13,374	16,663	21,861	28,421
Broilers	1000 lbs.	9,988	23,219	14,114	18,276	23,503
Sold	1000 dollars	1,488	3,460	2,004	2,595	3,338
Turkeys	1000 lbs.	13,960	13,852	18,219	24,629	31,810
Sold	1000 dollars	2,987	2,964	3,899	5,270	6,807
Value of all Livestock Products	1000 dollars	124,140	130,667	176,937	236,177	309,981

1/ All Products valued at 1964 prices.
2/ Projections were made before 1969 data was available.

Table 3-15

Rural Farm Work Force by Subareas,
Muskingum River Basin and Southeast Ohio 1959, 1964
and Projected to 1980, 2000, and 2020

Economic Subarea	Number of People in Rural Farm Work Force				
	1959 1/	1964 1/	1980	2000	2020
1	8,976	8,493	5,044	3,556	3,397
2	8,491	7,601	4,177	3,130	2,963
3	7,961	7,335	4,406	3,137	2,852
4	9,371	7,989	3,166	2,055	2,009
Muskingum River Economic Area	34,799	31,418	16,793	11,878	11,221

1/ Sum of all farm operators plus hired workers employed 150 days or more.

TABLE 3-16

Selected Components of Farm Income, 1964, 1969
and Projected, Muskingum River Economic Area

Item	1964	1969	1980	2000	2020
		1000 dollars1/			
1. Total value crops	94,688	96,219	135,615	163,729	196,940
2. Total value livestock	124,140	130,667	176,937	236,177	309,981
3. Miscl. commodities	11,162	11,216	16,223	21,298	27,541
4. Total value all commodities	229,990	238,102	328,777	421,204	534,544
5. Estimated cash receipts	177,182	186,715	257,505	338,065	437,152
6. Government payments	13,111	11,202	19,055	25,017	32,349
7. Farm production expenses2/	154,857	163,189	225,059	295,469	382,071
8. Net realized farm income	56,698	59,749	82,402	108,181	139,889
9. Net realized farm income excluding Govt. payments	43,587	48,546	63,347	83,164	107,540
10. Payments to hired workers	12,388	13,055	18,005	23,638	30,566
11. Total net income to operators and hired workers3/	55,975	61,601	81,352	106,802	138,106

1/ 1964 dollars

2/ Includes hired labor cost

3/ A constant 8 percent of farm production expenses is assumed to be paid to hired labor in the target years.

receipts from farm marketings are projected to rise from 186,715,000 dollars in 1969 to over 437,000,000 dollars in 2020.

With no allowance for future government payments, net income to farm operators will rise from 48,546,000 dollars in 1969 to over 107,540,000 dollars in 2020. Income to hired farm workers from farm employment will rise from about 13,055,000 dollars in 1969 to about 30,566,000 dollars in 2020. Thus income to both farm operators and hired workers is projected to increase from 61,601,000 dollars in 1969 to approximately 138,106,000 dollars in 2020.

5. Agriculturally Related Employment and Income

Industries closely related to agriculture include those supplying inputs to farmers and those purchasing farm products for processing or storage. Input suppliers include agricultural credit institutions, farm equipment dealers, oil and gas distributors, fertilizer and chemical dealers, feed processors and distributors, various repair and maintenance services, and hardware stores. Processors include vegetable canning, fruit canning and storage, feed milling companies, and meat packing plants.

Some businesses are more dependent on agricultural production than others according to their location and diversification in product lines. Some are entirely dependent on agriculture and will increase or decrease their number of employees as the demand for agricultural production from the MREA region influences their sales potential. Thus, if agricultural production increases as a result of water and land development related businesses will increase their output and employment according to their dependence on agricultural output. The multiplier effect of a change in agricultural production will depend on the portion of these related businesses located within the MREA region and the portion of inputs (outputs) which must be imported (exported).

Total value of fertilizer input in 1980 will amount to almost 23 million dollars (Table 3-17). Seed and chemicals bring the total to 33 million; and fuel, oil, and equipment raise it to about 53 million. Labor costs

TABLE 3-17

Cost of Selected Inputs to Crop Production,
Muskingum River Economic Area, 1980

Area	1000 Dollars
Southeast Ohio	
Nitrogen	13,000
Phosphorus	5,000
Potassium	5,000
Total Fertilizer Cost	23,000
Seed	5,000
Chemicals	3,400
Fuel, Oil and Equipment	21,000
Total Non-Labor Cost	52,500
Total Labor Cost	13,000
Total Cost	65,500

add another 13 million bringing the total cost of crop production projected for the MREA in 1980 to about 65 million dollars.

Out of each dollar of crop sales, farmers pay a portion to their input suppliers, a portion to hired labor, and retain a sizeable portion for return to capital and their own labor. If all input suppliers in the Southeast and Northeast areas of Ohio (including Cleveland)are included, the portion paid to each kind of industry is similar to the averages for the U.S. (Table 3-18). The percentages in Table 3-18 are those for the U.S. Economy. They are only approximate for the Eastern Ohio Region since Eastern Ohio may not contain all the industries from which the crop producers purchase inputs. To the extent that some inputs are imported from outside the MREA some of the percentages would be lower than those shown. If data for an input-output model of the 19 county area could be obtained, a table such as 3-18 could be compiled which would include an imports category. The column of percentages would be lower and the differences between the U.S. percentage and the 19 county percentage would be summed and shown as a percentage of total sales paid for imports.

The estimated multiplier for total output of the crop producing sector of the 19 county economy was about 1.6 in 1970 compared to about 1.9 for the entire U.S. economy. The total output of the crop sector is projected to increase from 96,219,000 dollars in 1969 to 135,615,000 in 1980. Assuming the multiplier for crop output will still be on the order of at least 1.5 in 1980, the total sales generated in 19 county economy due to crop output will be about 204,000,000 in 1980 compared to about 144,000,000 in 1969. Thus, between 1969 and 1980, the nonfarm economy which is related to the farm economy is likely to experience an increase in sales of about 60,000,000 dollars.

About 50 percent of the sales of the U.S. crops sector is value added5/ according to the 1967 U.S. input-output

5/ See Survey of Current Business, February 1974, pp. 24-56. Value added consists of employee compensation, proprietors income, rental income, corporate profits, net interest, business transfer payments, indirect business taxes, current surplus of government enterprises less subsides, and capital consumption allowances.

TABLE 3-18

Industry Sectors Supplying One Percent or More of the Total Purchases by the Food, Feed Grains, and Grass Seeds Sector of U.S. Economy 1/

Supplying Industry	Percent of Total Gross Outlay Paid to Indicated Sectors by the Food, Feed Grains, and Grass Seed Sector
Dairy Farm Products	1.6
Meat Animals and Misc. Livestock Products	5.2
Food, Feed Grains and Grass Seed	3.1
Agricultural, Forestry and Fishery Services	2.7
Maintenance and Repair Construction, all other	1.5
Industrial Inorganic and Organic Chemicals	1.7
Petroleum Refining and Related Products	4.4
Farm Machinery	1.2
Wholesale Trade	1.9
Retail Trade	1.3
Real Estate	8.6
Miscellaneous Business Services	3.9
Value Added 2/	51.4
TOTAL	88.5 3/

1/ Based on Input-Output Sample Surveys made by the Department of Commerce in 1963. See Input-Output Structure of the U.S. Economy: 1963, Vol. 2, Published in 1969 by the Department of Commerce, Office of Business Economics.

2/ Value added includes wages, profits, rents, interest taxes, transfers and depreciation.

3/ The remaining 11.5 percent was supplied by industries supplying less than one percent of total purchases.

model. Only eight percent of total sales was employee compensation while 38 percent was return to capital investment and the other three percent was indirect business taxes.

D. Outdoor Recreation and Related Economic Activity

Recreational activities such as camping, fishing, or picnicking, are sources of income to some farmers in the MREA. In 1969, 113 farms reported $199,841 income related to recreation activities (Table 3-19).6/ This is about one-half of one percent of the total number of farms. The number of farms participating in recreational activities is quite small, but the average income from this source is over $1700 per year per reporting farm.

Other businesses affected by recreational activities include motels, service stations, food establishments, and marinas. The multiplier effect of recreation income is usually not large, however. Direct income to businesses selling recreational services directly to consumers constitutes the largest portion of recreational income at the county level. The people benefiting most from recreational sales are those selling services directly. The multiplier for recreational sales is probably less than 1.5 for most counties and may be only around 2 for an area as large as the MREA. A study of Walworth County, Wisconsin revealed a recreation sales multiplier of about 1.6.7/ Most goods purchased by recreationists probably are manufactured outside the area where the purchase was made.8/

Even with low multipliers recreation should not be ignored as a potential source of income in Southeast Ohio. The terrain in the southern portion (Subarea 4) of

---

6/ 1969 Census of Agriculture.

7/ Robert Kalter, Estimating Local Secondary Impacts of Water based recreation using Interindustry Analysis, Univerity of Wisconsin Water Resources Center, Report 2.

8/ Marion Clawson and Jack Knetsch, Economics of Outdoor Recreation, John Hopkins press, 1966, p. 288.

TABLE 3-19

Number of Farms Participating and Income Reported From Farm Based Outdoor Recreation Enterprises in Southeast Ohio, 1969 1/

Subarea	County	No. Farms Reporting	Dollars Income From Recreational Services	No. Farms
I	Medina	13	25,445	1,288
	Stark	10	9,065	1,552
	Summit	2	9,080	315
	Wayne	15	10,739	2,051
	TOTAL	40	54,329	5,206
II	Ashland	5	15,003	1,476
	Knox	6	4,343	1,596
	Licking	3	3,756	1,944
	Richland	6	11,991	1,475
	TOTAL	20	35,093	6,491
III	Carroll	10	46,515	878
	Coshocton	8	27,134	1,171
	Harrison	-	-	602
	Holmes	7	2,658	1,537
	Tuscarawas	10	24,041	1,287
	TOTAL	35	100,348	5,475
IV	Guernsey	1	80	1,062
	Morgan	-	-	714
	Muskingum	9	3,180	1,291
	Noble	3	1,260	722
	Perry	2	4,351	812
	Washington	3	1,200	1,196
	TOTAL	18	10,071	5,797
MRB Total		113	199,841	22,969

Source: Census of Agriculture, 1969.

Employment in forest-related industries in approximately two percent of total basin employment.

The physical characteristics of the basin provide a significant source of recreational enjoyment for residents throughout the state.

the MREA is better suited for many recreational activities than those areas of the state which are level or flat. Also there are fewer competing uses for land. Agricultural land prices are lower in these areas because much of the land is rolling to hilly and better suited to pasture or woods than to intensive agricultural production.

State parks located in the MREA as of 1967 are shown in Table 3-20, on the following page.

E. <u>Forest Resources and Related Economic Activity</u>

1. Extent and Nature of the Resource

Of the six million acres in the MREA, about 2.08 million acres or 34 percent is forest land (Map 3-9). Ninety-nine percent of this area is classified as commercial forest land (see Table 3-21). This is forest land capable of producing crops of saleable wood. The remaining one percent is classified as non-commercial forest land which has been withdrawn from timber utilization through statute, ordinance, or administrative regulation. These latter forest lands, while not supplying forest products contribute to other resources such as wildlife habitat, watershed protection, and recreational use.

Approximately 77 percent of the commercial forest land is found in Economic Subareas III and IV. These commercial forest lands provide industrial wood products and contribute to the water, recreation, and fish and wildlife resources of the Basin. The extent to which these forest lands can supply sufficient resources will be influenced by land area, degree of stocking, composition of stand sizes, owership pattern and future forest management programs. The availability of timber depends greatly on the management decisions of private and public owners of forests.

Approximately 96 percent of the forested area is occupied by hardwood types (Table 3-22). The balance is in pine and other softwood types.

Table 3-20
State Parks in MREA by County, 1967

State Park	County	Total Area	Water Area
Mohican	Ashland	1,151	---
Salt Fork	Guernsey	19,711	---
Muskingum River Parkway	Morgan, Musk., and Wash.	116	---
Blue Rock	Muskingum	337	15
Dillon Reservoir	Muskingum	6,675	1,330
Wolf Run	Noble	1,166	220
Portage Lakes	Summit	2,443	2,150
MREA Totals		31,599	3,715
State Totals		125,172	50,568
MREA as Percent of State		25.2%	7.3%

Source: State of Ohio Statistical Abstract, 1969, p. 158.

Table 3-21
Commercial and Non-Commercial Forest Land by Subarea
Muskingum River Economic Area

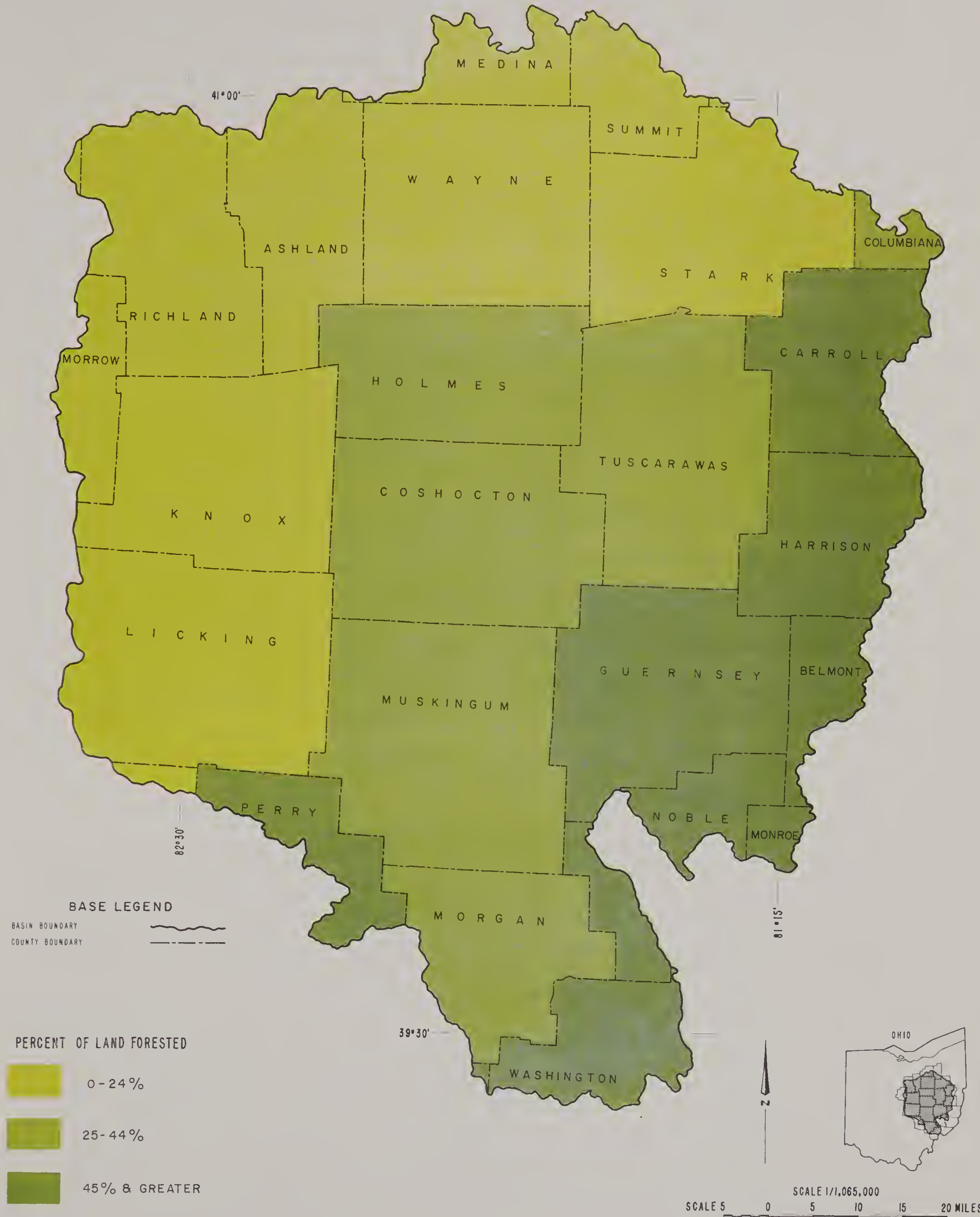
Economic Subarea	Commercial Forest	Non-Commercial Forest	Percent Commercial Forest
I	205,588	2,627	98.7
II	276,482	434	99.8
III	648,000	2,900	99.6
IV	933,589	14,700	98.4
TOTAL	2,073,659	20,661	99.0

MAP 3-9

PERCENT OF LAND FORESTED

MUSKINGUM RIVER BASIN

OHIO



SOURCE:
FAMILY OF MAPS SCS DRAWING NO.
5,R-32,783 (1-30-74) AND INFORMATION
FROM FIELD TECHNICIANS. TRANSVERSE
MERCATOR PROJECTION.

7-12-74
5,N-34,374

USDA-SCS-LINCOLN, NEBR. 1974

Ninety-four percent of the commercial forest land is owned by farmers and private land owners. Approximately one percent is industrially owned and five percent is public ownership.

2. Utilization: Kind, Volume, and Value of Output

Potential wood products from forest land are classified two ways, growing stock and sawtimber. Growing stock is more representative of the whole forest. It includes all of the sawtimber trees, pulpwood size trees, and seedlings and saplings. Sawtimber includes only the portion of the forest harvestable to sawlogs. Growing stock volume is expressed in cubic feet and sawtimber volume in board feet. Table 3-23 gives the volume of growing stock and sawtimber by species group for each economic subarea.

Between 1952 and 1966, 95 percent of the sawtimber cut in the MREA was hardwoods. During this same period, sawtimber cutting declined 10 percent. The decrease in sawtimber cutting was due to lower availability of high to average grade hardwood and mortality of American Elm from Dutch Elm disease. Although 63 percent of the growing stock volume is in sawtimber trees, only 23 percent of the sawtimber trees are 19 inches or more in diameter and two percent are in diameters larger than 29 inches.

Table 3-22

Area of Commercial Forest Land By Type
Muskingum River Economic Area

Type of Wood	Acres By Type	Percent
	Thousand Acres	
Oak-Pine	113.3	7.2
Oak-Hickory	703.4	44.6
Other Hardwoods	418.8	26.5
Maple-Beech	280.8	17.8
Softwoods	61.7	3.9
TOTALS	1,578.0	100.0

Table 3-23
Volume of Growing Stock and Sawtimber by Species
Group and Economic Subarea
Muskingum River Economic Area

Economic Subarea	Growing Stock			Sawtimber		
	Softwoods	Hardwoods	Total	Softwoods	Hardwoods	Total
	(Million Cubic Feet)			(Million Board Feet)		
I	1.0	120.4	121.4	2.6	417.5	420.1
II	0.5	136.0	136.5	0.9	503.7	504.6
III	10.8	347.3	358.1	31.1	1,192.5	1,223,6
IV	19.3	526.5	545.8	53.0	1,818.0	1,871.0
Total	31.6	1,130.2	1,161.8	87.6	3,931.7	4,019.3

Source: U.S. Forest Service Studies 1966 as revised 1968.

Volume and value of timber products cut in the MREA are shown in Table 3-24. Total output of timber products is projected to increase from 14.5 million cubic feet in 1962 to 44 million cubic feet by 2020. Pulpwood production is expected to increase seven times and nearly double sawtimber production. Fuelwood production is projected to decline over 40 percent by 2020. Total value of timber products will increase from 3.7 million dollars in 1962 to 10 million dollars by 2020.

Table 3-25 shows the added value of timber products manufactured during primary processing in the Basin.

The current annual growth for growing stock is projected to decline from 39.7 million cubic feet in 1967 to 32 million in 1980; then growth is expected to rise slowly to almost 45 million cubic feet by 2020. Ninety-seven percent of the growth is expected from hardwood trees and three percent from softwoods. Projections for timber cut, growth, and inventory volumes to the year 2020 are shown in Table 3-26.

According to the latest (1969) Forest Survey projections, removals (cutting) will not exceed annual growth till almost 2000, but since inventory exceeds removal by 16 times, there is no danger of a timber shortage in the Basin. There may be local shortages in the larger sizes of sawtimber, but good management could allow growth to larger sizes before cutting occurs.

3. Employment in Forest Related Industries

Employment in timber-based industries is expected to increase in the MREA through 2020. Total employment in forest related industries for 1962 was 11,426. This was approximately two percent of the total MREA employment. Total labor force is projected to increase to about 16,500 in 1980 and to 27,000 by 2020. It is estimated that forest based industries will employ 71 percent of the agriculture-forestry workers in 2020. This compares to 27 percent in 1950. Employment in timber-based industries will comprise approximately three percent of the Basin by 2020. Pulp, paper, and allied products industries accounts for 60 percent and lumber and wood products

Table 3-24
Volume and Value of Timber Products Output, 1952, 1962, and Projections to 1980, 2000, 2020 1/

Economic Subarea	1952	1962	1980	2000	2020
	Sawlogs, Veneer Logs, and Miscellaneous Industrial Products 2/				
	Volume - Million Cubic Feet				
I	.7	.7	9	1.4	1.5
II	.9	.8	1.0	1.5	1.7
III	2.3	2.1	2.6	4 0	4.5
IV	3.5	3.1	4.0	6.1	6.8
Total	7.4	6.7	8 5	13.0	14 5
	Value - Thousand Dollars				
I	228	206	262	399	447
II	256	232	294	449	503
III	673	607	771	1,178	1,320
IV	1,025	926	1,176	1,796	2,012
Total	2,182	1,971	2,503	3,822	4,282
	PULPWOOD - Volume - Million Cubic Feet				
I	Negl.	0.4	0.8	1.8	2 9
II	Negl.	0.4	0.9	2.1	3.2
III	0.2	1.2	2.4	5.3	8 4
IV	0.3	1.8	3.7	8.1	12.8
Total	0.5	3.8	7.8	17.3	27 3
	Value - Thousand Dollars				
I	11	76	155	344	541
II	12	86	174	386	609
III	32	225	457	1,013	1,597
IV	48	344	697	1,544	2,434
Total	103	731	1,483	3,287	5,181
	FUELWOOD - Volume - Million Cubic Feet				
I	0.6	0.4	0.3	0.3	0.2
II	0.7	0.5	0.4	0.3	0.3
III	1.8	1.2	1.0	0.9	0.7
IV	2.7	1.9	1.5	1.3	1.1
Total	5.8	4.0	3 2	2.8	2.3
	Value - Thousand Dollars				
I	145	104	80	69	57
II	163	117	91	77	64
III	427	308	238	203	168
IV	651	469	363	309	256
Total	1,386	998	772	658	545

1/ As of January 1, 1952, and January 1, 1962, and using 1962 dollar values.
2/ Minor industrial products include cooperage logs, poles, piling, mine timbers, posts, boxbolts, etc.

Table 3-25
Added Value of Timber Cut In
Muskingum River Economic Area

Economic Subarea	Products	1952 Cut	1952 Added Value1/	1967 Cut	1967 Added Value1/	1980 Cut	1980 Added Value1/
		1,000 c.f.	$1,000	1,000 c.f.	$1,000	1,000 c.f.	$1,000
I	Sawlogs	580	1,329	600	1,375	810	1,856
	Veneer Logs	20	104	30	156	40	208
	Pulpwood	200	328	340	558	450	738
	Other	500	1,349	530	1,430	700	1,889
	SUBTOTAL	1,300	3,110	1,500	3,519	2,000	4,691
II	Sawlogs	630	1,444	650	1,490	890	2,040
	Veneer Logs	20	104	30	156	50	260
	Pulpwood	220	361	360	591	490	804
	Other	530	1,430	560	1,511	770	2,077
	SUBTOTAL	1,400	3,339	1,600	3,748	2,200	5,181
III	Sawlogs	1,670	3,827	1,730	3,965	2,380	5,454
	Veneer Logs	60	312	100	520	130	676
	Pulpwood	570	935	970	1,591	1,330	2,182
	Other	1,400	3,777	1,500	4,047	2,060	5,557
	SUBTOTAL	3,700	8,851	4,300	10,123	5,900	13,869
IV	Sawlogs	2,570	5,890	2,620	6,004	3,630	8,319
	Veneer Logs	90	468	140	728	200	1,040
	Pulpwood	870	1,427	1,460	2,395	2,020	3,314
	Other	2,170	5,854	2,280	6,151	3,150	8,498
	SUBTOTAL	5,700	13,639	6,500	15,278	9,000	21,171
	GRAND TOTAL	12,100	28,939	13,900	32,668	19,100	44,912

1/ Computed at 25x stumpage value, using 1958 dollar values for future values. Added value means the value of the delivered finished products manufactured from the raw material listed above.

Table 3-25 cont'd

Economic Subarea	Products	2000 Cut	2000 Added Value1/	2020 Cut	2020 Added Value
		1,000 c.f.	$1,000	1,000 c.f.	$1,000
I	Sawlogs	1,450	3,323	1,890	4,332
	Veneer Logs	80	416	100	520
	Pulpwood	810	1,329	1,060	1,739
	Other	1,260	3,399	1,650	4,451
	SUBTOTAL	3,600	8,467	4,700	11,042
II	Sawlogs	1,610	3,690	2,100	4,813
	Veneer Logs	90	468	110	572
	Pulpwood	900	1,476	1,170	1,919
	Other	1,400	3,777	1,820	4,910
	SUBTOTAL	4,000	9,411	5,200	12,214
III	Sawlogs	4,270	9,786	5,520	12,650
	Veneer Logs	230	1,196	300	1,560
	Pulpwood	2,390	3,921	3,080	5,053
	Other	3,710	10,009	4,800	12,949
	SUBTOTAL	10,600	24,912	13,700	32,212
IV	Sawlogs	6,530	14,965	8,460	19,388
	Veneer Logs	360	1,872	460	2,392
	Pulpwood	3,640	5,971	4,730	7,760
	Other	5,670	15,296	7,350	19,828
	SUBTOTAL	16,200	38,104	21,000	49,368
	GRAND TOTAL	34,400	80,894	44,600	104,836

1/ Computed at 25x stumpage value, using 1958 dollar values for future values. Added value means the value of the delivered finished products manufactured from the raw material listed above.

Table 3-26
Timber Cut, Growth, and Inventory of
all Species of Growing Stock from Commercial Forest Land,
by Economic Subareas in 1952 and 1967, and
Projections to 1980, 2000, and 2020

Year		Economic Subareas I	II	III	IV	Totals
		Millions of Cubic Feet1/				
	Cut	1.3	1.4	3.7	5.7	12.1
1952	Growth	3.0	3.4	8.9	13.6	28.9
	Inventory	93.2	104.8	274.9	419.1	892.0
	Cut	1.5	1.6	4.3	6.5	13.9
1967	Growth	4.2	4.7	12.2	18.6	39.7
	Inventory	121.4	136.5	358.1	545.8	1161.8
	Cut	2.0	2.2	5.9	9.0	19.1
1980	Growth	3.3	3.8	9.9	15.0	32.0
	Inventory	149.3	167.9	440.4	671.4	1429.0
	Cut	3.6	4.0	10.6	16.2	34.4
2000	Growth	4.0	4.5	11.9	18.0	38.4
	Inventory	162.9	183.2	480.5	732.4	1559.0
	Cut	4.7	5.2	13.7	21.0	44.6
2020	Growth	4.7	5.3	13.8	21.0	44.8
	Inventory	166.3	186.9	490.4	747.4	1591.0

Note: Growing Stock includes sawtimber and poletimber.

1/ Source: Basic Forest Resource Statistics for the Ohio River Basin, 1963, with revised figures for 1967 from USFS Forest Survey.

industries over 30 percent of total employment. It is expected to continue in the same proportion through 2020. Table 3-27 shows a breakdown of forest related employment by economic subareas.

F. Relationship of Economic Development and Water Resource Development

Water is an important input in many industrial and agricultural production processes. When the necessary quantity and quality of water is limited, the production of goods may be limited. This can result in a lower level of economic activity than desired by the local people.

Economic development in the Muskingum Basin has not been severely hampered by water shortages. Many industries have developed their own supplies either from underground water or from year round streams above ground. The Ohio Department of Natural Resources, Division of Water, has prepared a summary of municipal water supply facilities and a map showing principle public and private water uses in the Basin.9/

Most community leaders are aware of the importance of water in attracting industry and take the necessary steps to insure that water is not a constraint on their economic development. If water is a limiting factor and there is a choice as to the type of industry to attract, decision should be to choose the industry that will yield the greatest benefits to the community relative to its water use. The considerations are complex and no flat statement can be made as to the type of industry to encourage when water is limiting. Community leaders must evaluate the "trade-offs" in terms of employment, income and environmental effects for each potential industry.

9/ See "Water Inventory of the Muskingum River Basin," State of Ohio, Department of Natural Resources, Division of Water, Report No. 21, p. 110.

Table 3-27
Estimated Employment, by Economic Subareas,
in Timber-Based Industries, 1952, 1962 with Projections to 1980 and 2020 1/

Year	Total	Lumber and Wood Products	Furniture	Pulp, Paper and Applied Products	Total	Lumber and Wood Products	Furniture	Pulp, Paper and Applied Products
		Economic Subarea I				Economic Subarea II		
1952	7,041	2,278	341	4,422	1,164	377	56	731
1962	6,914	2,237	335	4,342	1,143	370	55	718
1980	8,835	2,827	442	5,566	3,044	974	152	1,918
2000	11,651	3,728	583	7,340	4,013	1,284	201	2,528
2020	14,494	4,638	725	9,131	4,994	1,598	250	3,146
		Economic Subarea III				Economic Subarea IV		
1952	2,547	824	123	1,600	885	286	43	556
1962	2,502	810	121	1,571	867	280	42	545
1980	2,929	937	147	1,845	1,645	526	82	1,037
2000	3,862	1,236	193	2,433	2,433	694	108	1,367
2020	4,803	1,537	240	3,026	2,699	864	135	1,700

1/ As of January 1, 1952, and January 1, 1962.

Chapter 4

WATER AND RELATED LAND RESOURCE PROBLEMS

MUSKINGUM RIVER BASIN

Chapter 4. Water and Related Land Resource Problems

A. Erosion Damage - Sheet, Gully, Channel, Scour and Wind

B. Sediment Damage - Land, Channels, Reservoirs, Water Supplies and Other Property

C. Floodwater Damage
   1. Agriculture: Crops, Pasture, Forests, etc.
   2. Nonagriculture: Urban, Transportation, etc.

D. Impaired Drainage

E. Water Supply Problems
   1. Agricultural Crops
   2. Livestock and Rural Domestic
   3. Nonagricultural: Municipal and Industrial, Recreation, L.F. Aug., etc.

F. Pollution
   1. Sources and Types
   2. Effects: Water Supplies, Fish and Wildlife, Health, Stream and Flood Plain Use, etc.

Water and Related Land Resource Problems

Soil and water management problems within the Basin have been recognized for several decades. Excess surface runoff with accompanied soil erosion, sedimentation, and flooding came to be considered intolerable. Soil and water conservation practices were developed and applied. Today such practices as contour and strip farming, terraces, diversions, and rotation farming are accepted basin wide as viable solutions to many of the water and related land resource problems. In association with the land treatment measures, numerous flood retarding reservoirs were constructed to further reduce problems created by excess runoffs. Although these measures have had a marked effect in controlling and conserving soil and water, much remains to be done to fully utilize and conserve these resources. Man demands, and will continue to require, the use of these resources. Problems that go into the future unsolved will have adverse effects on the environment and on the quality and quantity of the resources. Problems requiring corrective measures are discussed below.

A. Erosion Damage--Sheet, Gully, Channel, Scour, and Wind

A common problem relative to the Major Land Resource Areas, Map 4-1, is erosion. Erosion and resultant sedimentation constitute damage problems to both urban properties and the land resources. Erosion causes the gradual loss of soil on farmlands, resulting in the irreplaceable depletion of the soil resource. Sediment is a product of erosion and represents a significant damage to flood plain lands, reservoirs, channels, and water quality. Some highly-erosive soils in the Basin require extensive conservation techniques for economic production. If poorly managed, lands of these soil types are highly susceptible to severe sheet and gully erosion. (See Table 4-1)

The predominant types of erosion in the Muskingum River Basin are sheet and rill, gully, flood plain scour, and channel erosion.

Sheet erosion is the gradual removal of the soil, layer by layer, by overland sheet flow. Sheet erosion is

TABLE 4-1

Characteristics of Major Land Resource Areas*

MLRA 111

Eight percent of total area of Muskingum River Basin.
Indiana and Ohio Till Plains
Glacial materials, mostly limestone
Western cash grain and livestock farming.
MAJOR SOIL TYPES: Crosby, Brookston, Miamian, Blount, Pewamo, Morley, and Fox.
SOILS WITH EROSION HAZARDS WHEN CULTIVATED: Miamian and Morley.

MLRA 124

Forty-five percent of total area of Muskingum River Basin.
Western Allegheny Plateau
Residual sandstone and shale materials
Southeast pasture and woodland hills
MAJOR SOILS TYPES: Muskingum, Wellston, Gilpin, and Rarden.
SOILS WITH EROSION HAZARDS WHEN CULTIVATED: Muskingum and Gilpin.

MLRA 126

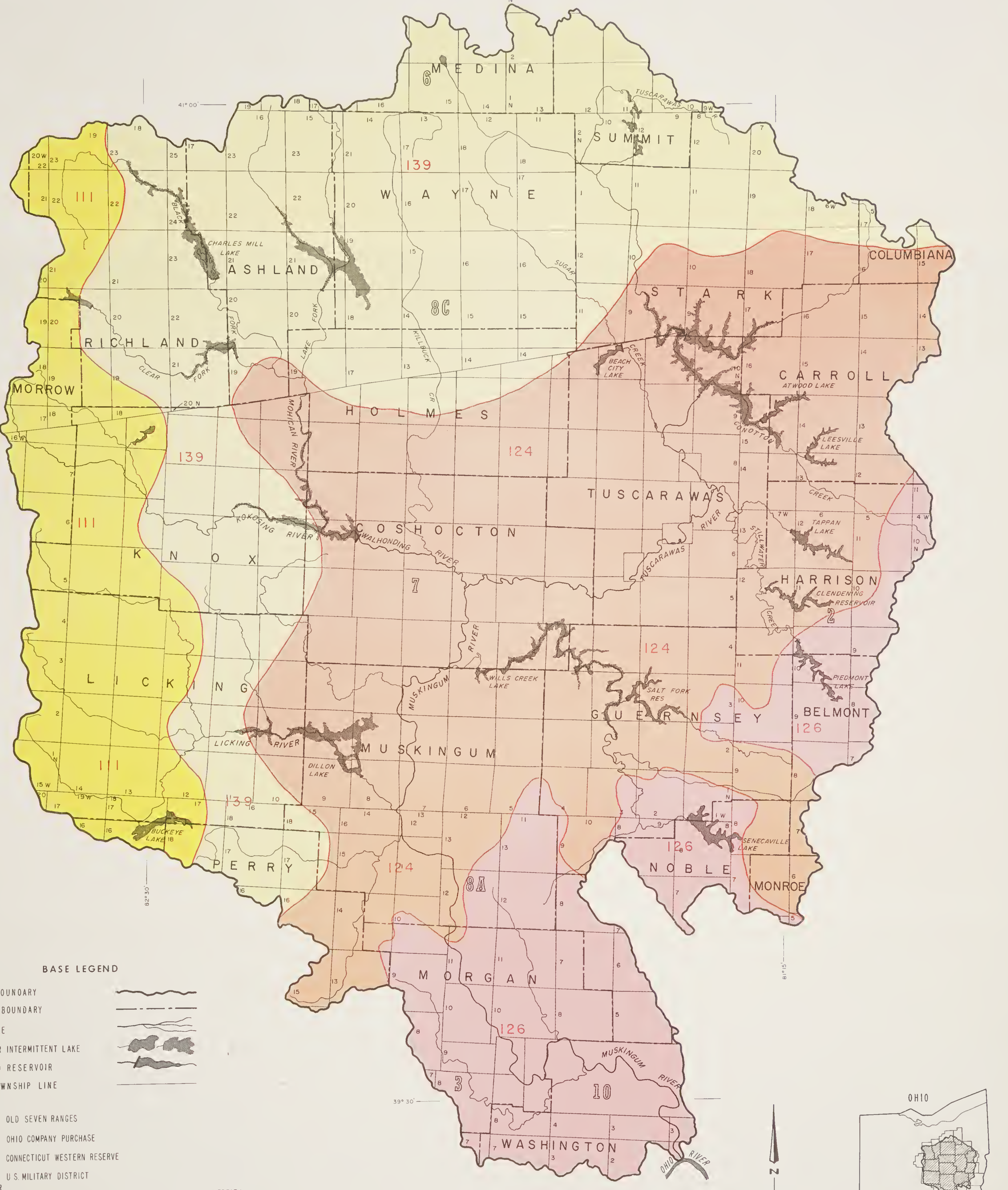
Twenty percent of total area of Muskingum River Basin
Central Allegheny Plateau
Residual sandstone and red shale materials
Southeast woodland and pasture benchy hills
MAJOR SOIL TYPES: Gilpin, Upshur, Guernsey, and Westmore.
SOILS WITH EROSION HAZARDS WHEN CULTIVATED: Gilpin and Westmore.

MLRA 139

Twenty-seven percent of total area of Muskingum River Basin.
Eastern Ohio Till Plains
Glacial materials, mostly sandstone and shale
Northeast dairy, forage, and small grain farming
MAJOR SOIL TYPES: Rittman, Mahoning, Platea, Canfield, and Chili.
SOIL WITH EROSION HAZARDS WHEN CULTIVATED: Rittman

*Taken from Conservation Needs Inventory, 1971

U. S. DEPARTMENT OF AGRICULTURE



BASE LEGEND

- BASIN BOUNDARY
- COUNTY BOUNDARY
- DRAINAGE
- LAKE OR INTERMITTENT LAKE
- DAM AND RESERVOIR
- GLO TOWNSHIP LINE

2 OLD SEVEN RANGES
3 OHIO COMPANY PURCHASE
6 CONNECTICUT WESTERN RESERVE
7 U.S. MILITARY DISTRICT
8A CONGRESS LANDS EAST OF THE SCIOTO RIVER BY GREENVILLE TREATY
8C CONGRESS LANDS NORTH OF THE OLD SEVEN RANGES
10 DONATION TRACT

LEGEND

- 111 MAJOR LAND RESOURCE AREA
- 124 MAJOR LAND RESOURCE AREA
- 126 MAJOR LAND RESOURCE AREA
- 139 MAJOR LAND RESOURCE AREA

MAJOR LAND RESOURCE AREAS
MUSKINGUM RIVER BASIN
OHIO

MAP 4-1

SOURCE: FAMILY OF MAPS SCS DRAWING NO. [illegible] AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE [illegible]

USDA-SCS LINCOLN NEBR 1974

9-12-74
5,P-34,376

the major type of erosion in the Basin and produces the greatest quantity of sediment. Rill erosion sometimes occurs with sheet erosion, producing small rivulet channelways where overland flow becomes concentrated. Left untreated, rills may develop into deep gullies, causing severe damage. Wind erosion, a type of sheet erosion, is not considered a significant problem in the Basin.

Gully erosion causes localized problems and constitutes the most severe type of erosion damage on forest land, pasture, and cropland. Areas damaged by gully erosion are often left untreated due to high costs of recovery.

Flood plain scour is the result of shallow, high velocity out-of-bank flows from streams during periods of flooding. Severe damage to cropland on the flood plain is the most significant result of flood plain scour: fertilizer and other nutrients, topsoil, and sometimes entire crops are washed away and destroyed.

Although damage incurred by gullying and flood plain scour is severe, the areas affected in the Basin are localized and do not constitute major problem areas.

Channel erosion is the bankcutting and streambed incision caused by moving water. It is revealed in the form of scour, slumping, or the gradual degradation of streambanks and downcutting of the streambed. Some of the more serious types of damages caused by channel erosion are bridge abutment washouts (highway and railroad), loss of roadbed when built next to streams, and undercutting of structural works (buildings including commercial, public, and private structures, plant facilities, etc.) located too near the stream channel banks. These problems represent local damages but are not significant in the Basin as a whole.

Other sources of erosion in the Basin are the direct result of man's cultural activities: unvegetated roadside banks, areas of new construction, poorly-managed feed lots, and new or untreated stripmine areas that become severely damaged if conservation practices are not implemented. Disturbed or unvegetated, untreated land is susceptible to accelerated erosion, creating advanced rills and mature gullies. Resultant aesthetic and

Estimated average annual gross erosion and sediment production for the basin is estimated at 4.65 tons per acre.

Road and bridge floodwater damage occurs throughout the basin and represents a large economic loss.

economic damages are severe, although generally on localized areas. Improper forest management practices, such as over-grazing woodland, careless logging methods, and little or no control of logging road and skid trail layout, eventually lead to site deterioration by erosion. Depending on the severity of the initial damage, forest land may show effects of sheet, gully, or channel erosion, thereby, resulting in muddy streams and sediment deposition in stream channels and existing reservoirs. Table 4-2 shows various erosion levels for forest land by economic subareas.

According to the Conservation Needs Inventory of 1971, approximately 109,000 acres, or 2.1 percent of the Basin, has erosion damage. Field reconnaissance and map-type investigations were made to determine sediment storage requirements for potential reservoir sites. These would control 16 percent of the drainage area within the Basin. These sites are randomly distributed and occurr in all major sub-basins. Random distribution, size of investigation drainage areas, and wide range of cover conditions afford a good representative sample for the Basin. Gross erosion rates were developed for sediment storage requirements in potential reservoir sites. The average annual gross erosion and sediment production for the Muskingum River Basin is estimated at 4.65 tons/acre of which 4.12 tons/acre occurs on urban, agricultural, and other lands and 0.53 tons/acre occurs on forested and strip mined land.

B. Sediment Damage--Land, Channels, Reservoirs, Water <u>Supplies and Other Property</u>

It is estimated that approximately 622,965 tons or 0.12 tons/acre of sediment is yielded at the mouth of the Muskingum River annually or about 2.6 percent of the average annual gross erosion.

Sediment causes significant damages to land and water resources of the Basin. Direct damages from sediment concentration and accumulation are stream channel constriction, cropland burial, degraded water quality, and urban structural damages. An indirect damage attributed sedimentation is the incorporation of a storage safety factor in the design of existing and planned reservoirs. Additional capacity is required to accommodate sediment in reservoirs.

Table 4-2
Forest Land Erosion by Economic Subareas
From 1967 C.N.I. Files
Muskingum River Economic Area, Ohio

Economic Subarea	Forest Land Erosion				
	None	Slight	Moderate	Severe	Total
	- - - - - - - - - -	- - - ACRES-	- - - - - -	- - - - - -	- - - - - -
I	55,896	124,515	21,404	598	202,313
II	40,106	207,324	58,751	1,504	307,685
III	64,752	354,132	181,805	11,792	612,481
IV	57,409	518,353	376,983	9,096	961,841
TOTAL	218,063	1,204,324	638,943	22,990	2,084,320

Deposition of sediment in streams and channelways is presently the most significant sediment-related damage problem in the Muskingum River Basin. Approximately 237,300 acres, or 4.6 percent of the Basin, has floodwater and sediment damage. Areas which receive most damage are those which lie downstream from areas of critical erosion.

Sediment deposited in channels reduces waterflow capacity and decreases hydraulic efficiency. This results in more frequent flooding and increases the severity of flood plain damages. Flood plain scour and deposition of infertile overwash become more frequent in degree and extent as hydraulic capacity decreases. Tile drains sometimes become blocked, and surface drainage systems backflood, inflicting both floodwater and sediment damage to surrounding fields and communities.

In some localized areas, out-of-bank flow during periods of flooding is sometimes trapped behind natural levees and other sediment blockages, creating swampy areas.

Occasionally highways, railroads, bridges, and other transportation arteries are inundated during flooding, resulting in sediment damage. Sediment also damages urban properties, requiring clean-up and disposal of sediments deposited on lawns; in houses, factories, business establishments, public buildings and facilities.

Cropland damages occur when sediment is deposited on fields. Various methods of restoring the desired degree of fertility are required. In extreme cases the damaged land is abandoned. Sediment also causes damage to crops, especially at the harvest stage, when the fine suspended particles deposit on them. This results in an undesirable product, reduces its market value, and often requires cleaning of the produce before it can be utilized.

Problems mentioned above generally occur at a local level and are not widespread within the Basin.

Although not a major problem in the Basin, sediment is the largest single pollutant of water. Before use for municipal and most industrial purposes, water must be treated to remove suspended sediment. It must be

filtered and/or chemically treated before use. The USGS reports that 592,411 tons of suspended sediment passed the Dresden sediment sampling gaging station in Muskingum County during the water year 1970-71. A water year is a complete water cycle from October 1 to September 30.

C. Floodwater Problems

Problems which occur from the inundation of flood plain lands and improvements exist on an estimated 237,300 acres.

The nature, characteristics, and severity of flood problems are fairly uniform throughout the Basin. Dendritic or tree like drainage patterns occur in all parts of the Basin. Narrow flood plain widths are typical for about two thirds of the Basin's area. The average flood plain width for the greater portion of the Basin is about 800 feet per one hundred square miles of drainage area. Flood plain widths exceeding 800 feet are located mostly in the northeast portion of the Basin. Killbuck Creek sub-basin is a notable example, with flood plain widths up to 4,000 feet.

Floodwater damages occur during large runoff events when shallow and swift moving waters inundate flood plains. Damages occur on agricultural lands, urban areas and to roads and bridges. Recent recorded large events were the 1963 storm over Crooked Creek lateral on Wills Creek and the 1969 event centered over Killbuck Creek.

Severity of floodwater damages to crop and pasture is determined according to seasonality of storm events. Damages are most severe from events which occur during the growing season. Figure 4-1 shows on an average, what percent of the total number of significant events occur each month.

Nonagricultural damages are estimated to be over $1.48 million annually. Damages of this type are 49 percent of the total floodwater damage. Extent of these damages varies among the different watershed areas, and it is affected by numerous factors. Among these are current economic conditions, historical development, topography, and other factors which influence the transportation network throughout the Basin. (See Table 4-3 for annual floodwater damages by subbasins.)

Floodwater damage to a field of soybeans from the July 4, 1969 flood.

A home destroyed in Richland County from the flood of July 4, 1969.

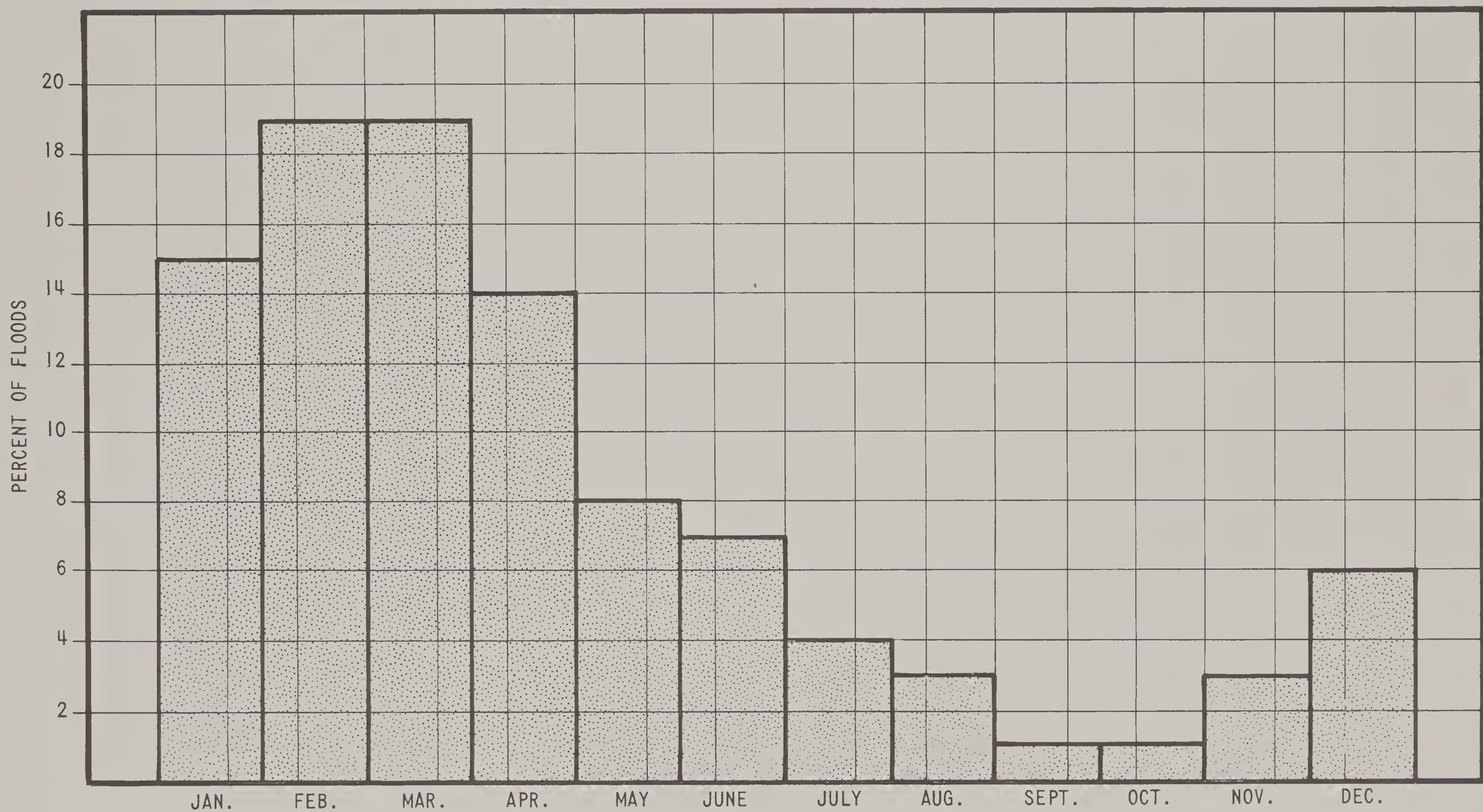
TABLE 4-3
Floodwater Damage
Muskingum River Basin, Ohio

Sub-Basin	Average Annual Floodwater Damage 1/2/ Crop and Pasture	Other Agr. 3/	Non-Agr. 4/
1. Wolf Creek	42,400	9,800	19,600
2. Maxahala-Jonathan Creek	38,600	10,800	213,800
3. Licking River	415,800	86,000	215,100
4. Kokosing River	76,500	13,000	32,800
5. Mohican River	122,500	25,000	60,900
6. Killbuck Creek	201,600	41,000	605,600
7. Sugar Creek	41,900	8,500	37,000
8. Upper Tuscarawas River	168,900	9,900	58,200
9. Sandy Creek	54,900	11,200	81,600
10. Conotton Creek	1,600	200	77,700
11. Stillwater Creek	45,500	9,300	15,100
12. Wills Creek	50,400	10,300	38,200
13. Wakatomika Creek	74,600	20,300	29,700
TOTAL	1,335,200	255,300	1,485,300

1/ Projected at 5 7/8 percent 100 year.
2/ Direct damages only.
3/ Damages to fences, agricultural buildings, equipment, etc.
4/ Damages to urban and transportation.

Figure 4-1

PERCENT OF FLOODING OCCURRING BY MONTH



D. Impaired Drainage

Approximately 24 percent of the cropland in tillage rotation is on soils that have an excessive moisture condition. Problems range from those that can be solved by such conservation practices as providing annual cover, sod in rotation, surface drainage, and permanent cover to more severe conditions requiring tile or open ditch drainage. It is estimated that 35 percent of the rotation cropland in wet soils have been adequately treated. Table 4-4 shows acres of total cropland in tillage rotation which need treatment to utilize the cropland to its maximum potential.

Lands presently drained by ditch or tile drainage and lands requiring such measures in the future depend on adequate outlets into streams. Much of the wet lands, especially in the southeast third of the Basin, is in small plots strung ribbon like along streams. Poorly maintained channels where vegetation has allowed to grow without control have reduced average flow velocities. This reduction permits more of the water borne materials to settle out on streambanks and streambeds. This process is progressive and may eventually block drainage outlets. Poor maintenance of existing outlets has caused presently installed drainage systems to function inefficiently. The individual land operator often has little authority or resources to rejuvenate his drainage outlets. Groups of farmers have organized for group drainage projects or petitioned for watershed improvement under PL 566.

E. Water Supply Problems

Irrigation water is supplied to about 4000 acres within the Basin. Natural moisture is normally available in sufficient quantity and distribution to provide adequate economic returns from agricultural usage within most of the Basin. Inadequate moisture limits utilization of the lands to less than maximum potential production. Rainfall does not usually occur in time and quantity for most efficient utilization by crops. Approximately 36 percent of the rainfall occurs during the nongrowing season. A portion of the rainfall which falls during the growing season is not infiltrated into the soil and is thus lost as a possible benefit to plant growth. Average annual runoff is estimated at 13 inches.

TABLE 4-4

Projected Cropland Acreage For Which Yields Could Be Increased By Proper Water Management, by SRG, by Economic Subarea, 1980 (19 SEO Counties)

			Subareas								
			1		2		3		4		
SRG No.	Corn Yield Rank	Typical Land Capability Unit	P[1]	F[2]	P	F	P	F	P	F	Totals
1	4	1-103	90	243	-	-	1,745	4,652	565	1,528	8,823
2	10	2e-404	-	-	-	-	-	-	-	-	-
3	5	2e-274	94	182	971	1,654	-	-	-	-	2,901
4	8	2e-275	-	-	-	-	-	-	-	-	-
5	15	2e-443	-	-	-	-	350	865	-	-	1,215
6	9	2e-713	4,600	4,132	433	368	291	622	793	1,153	12,392
7	16	3e-406	-	205	-	-	-	-	-	-	205
8	3	2w-102	3,317	4,054	2,748	3,359	6,304	7,705	4,695	5,738	37,920
9	1	3w-000	11,048	4,296	312	121	-	-	-	-	15,777
10	11	2w-6BB	5,597	3,732	27,603	18,401	1,520	1,013	862	575	59,303
11	6	2w-712	7,041	10,560	859	1,286	365	548	-	-	20,659
12	17	3e-404	-	206	362	542	-	-	-	-	1,110
13	18	3e-443	-	-	-	-	101	303	-	-	404
14	20	3e-486	1,136	1,704	2,446	3,670	-	-	-	-	8,956

Table 4-4 cont'd

			Subareas								
			1		2		3		4		
SRG No.	Corn Yield Rank	Typical Land Capability Unit	P[1]	F[2]	P	F	P	F	P	F	Totals
15	12	3e-783	211	569	-	-	-	-	289	782	1,851
16	7	3w-141	732	1,883	1,596	4,107	1,027	2,640	603	1,550	14,138
17	21	3w-751	4,559	3,039	2,144	1,430	-	-	-	-	11,172
18	14	3w-7AB	20,286	37,675	998	1,854	2,013	3,739	377	700	67,642
19	2	2w-60B	5,771	1,382	37,206	6,565	-	-	1,919	339	53,182
20	19	4e-486	-	199	365	622	53	91	-	-	1,330
21	22	4e-406	-	-	-	-	-	-	-	-	-
22	24	6e-476	-	-	-	-	-	-	-	-	-
23	23	7e-476	-	-	-	-	-	-	-	-	-
24	25	Stripped	-	-	-	-	-	-	-	-	-
25	13	3e-274	-	180	-	-	-	-	-	-	180
	TOTAL MREA		64,482	74,241	78,043	43,979	13,769	22,178	10,103	12,365	319,160

1. P is the acreage requiring partial drainage.

2. F is the acreage requiring full drainage.

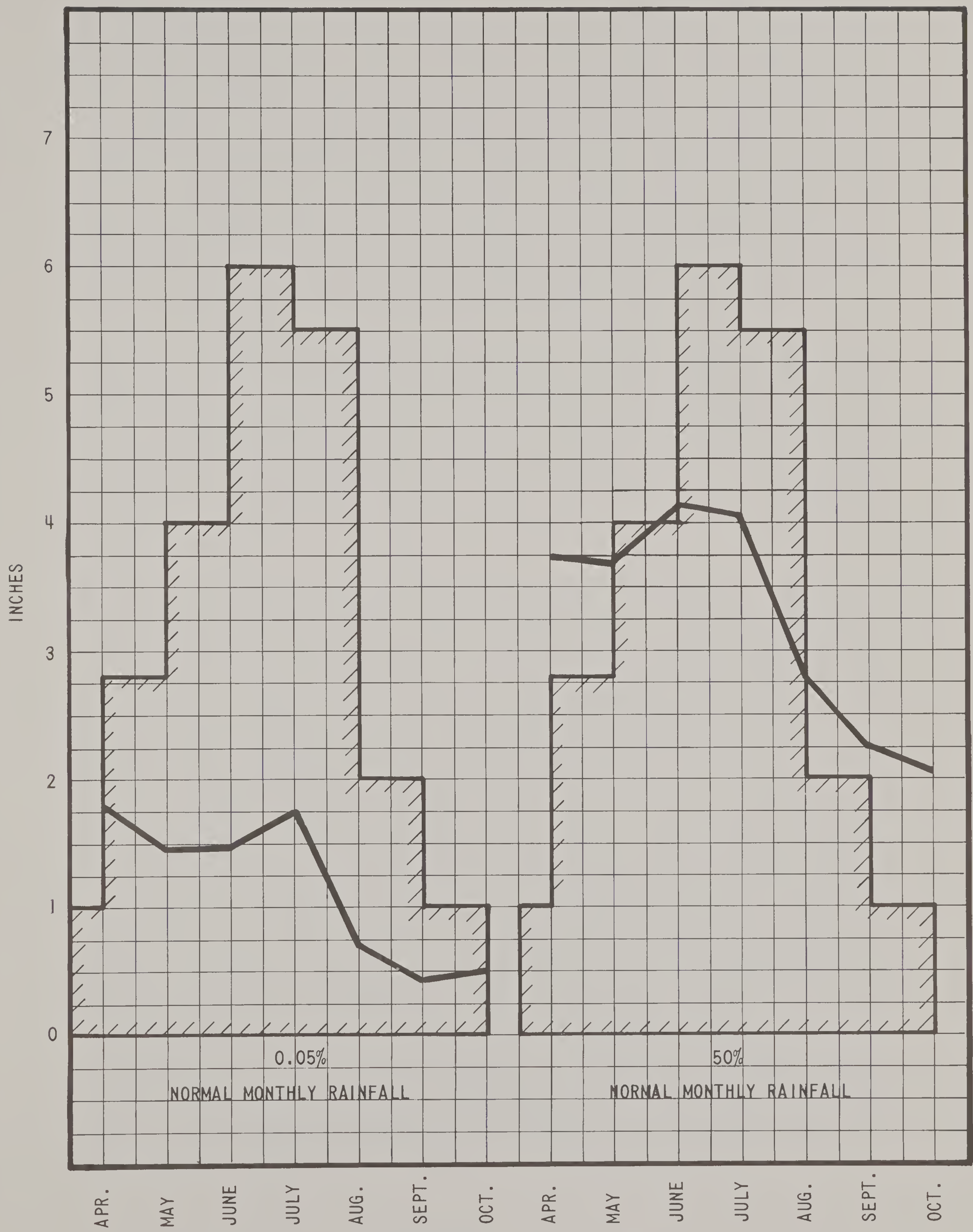
Figure 4-2 shows relationship between the water requirement for corn and expected monthly rainfall for May through September. The figure shows the crop's moisture requirements for top yields and quality. If moisture is not available from rainfall, it must be supplied from the moisture reserves. The longer the drought condition exists, the more depleted the soil moisture reserve becomes and crops show increasing effects from moisture shortage. For certain speciality crops such as vegetables, nurseries, and high tonnage pastures, drought effects are sufficiently severe to justify irrigation. Water supplies to meet future agricultural crop water demands are not expected to be a major problem. The Basin has a broad band of rich, well-drained Wooster-Canfield-Massillon soils crossing Richland, Ashland, Wayne-Stark, and Columbiana counties which can continue to provide a large share of agricultural products without requiring supplemental moisture.

The problem of sufficient farm water supply for domestic and livestock use is often one of economics. Underground sources can usually be developed to provide the entire farmstead needs. In certain areas in the southeast third of the basin underground sources are inadequate thus requiring cistern, pond, or community developments. These type developments can be utilized throughout the Basin when economically expedient. The <u>1966 Conservation Needs Inventory</u> states that 3509 farm households in the Basin have inadequate water supplies. In addition 2440 nonfarm households have the same problem.

The water problems that exist now and those that will occur in the future stem from economic and conservation considerations. Urban communities and industries have made the necessary capital expenditures to provide themselves the necessary supplies. Some developments are stop gap measures. Short range plans can and have resulted in inefficiencies as additional loads are applied to the development. Water supply developments have not generally provided for the necessary quantities to dilute sewage and industrial wastes emanating from the service area. However, plants throughout the country are using effluent from municipal sewage disposal plants as a source of industrial water supply. This practice, if more widely adopted, would utilize the natural water resources more efficiently.

Figure 4-2

MONTHLY MOISTURE NEEDS OF CORN
AT COSHOCTON, OHIO FOR A NORMAL YEAR



Although the Muskingum River Basin is considered the "Mecca" for quality water based recreation in Ohio, certain problems exist presently and additional problems are expected in the future. Recreational facilities serve not only the Basin itself, but many users are drawn from the highly populated areas of northeast Ohio as well as other parts of Ohio and other states. The types of recreational pursuit which attracts the largest number of outside users are camping, picnicking, and hiking. These are grouped as land-oriented activities. Swimming is another activity which draws many users into the area. Many of these users utilize facilities in the north urban rim counties of Richland, Ashland and Stark due to the short access time to the facilities.

Major recreational problems at the present are inadequate accesses to existing water, particularly in streams and rivers, and insufficient support facilities where extensive recreational areas exist. More than half the total available water supply for boating is in the river systems. Much of the land adjacent to streams is privately owned and no provisions have been made for public access.

With the present level of development, demand is expected to exceed supply in all water and water associated recreational activities. These include boating, fishing, swimming, and land-based pursuits. By 2020 demand will increase dramatically over 1970 demand levels. Boating will increase 2.4 times, fishing 1.4 times, swimming 2.5 times and land-oriented activities 4.3 times. Demand will not increase uniformly throughout the Basin. The North Urban Rim counties had 46 percent of the total Basin demand for boating in 1970 and will increase to 50 percent by 2020. Percentage of demand for fishing in the same counties will increase from 40 to 44 percent. The sum of the demand from the North Urban Rim counties ranges from 70 percent in 1970 to 76 percent of total Basin demand in 2020. Water-based activities like swimming will draw heavily from outside areas. These visitors plus demand in the northern three counties accounted for 50 percent of demand in 1970 and will account for 73 percent in 2020. Plans to provide additional facilities should reflect, in types and distribution, the uneven spread of demand. It is clear that the most severe problem lies in the North Urban Rim.

Lack of maintenance has reduced the channels capacity. This is a problem in the basin.

Junk yards along roadways mar the natural beauty of the area plus being possible health and safety hazards.

F. Pollution

The Water Control Board of the Ohio Department of Health adopted water quality standards for the Muskingum River Basin on November 12, 1969. On April 14, 1970, the board strengthened the criteria by amendment. Most waters in the Basin were classified as to appropriate uses. Jonathan Creek, Moxahala Creek, and tributaries in the coal-bearing areas flowing directly into the Muskingum River below Coshocton were not classified.

Pollutants originating from municipal and industrial wastes is significant. The Board through its issuance of discharge permits, has control over pollution from municipal and industrial point discharges. Time tables have been established for each such contributor to meet certain standards. Water quality will be vastly improved as the programmed abatment measures are applied.

The agricultural pollution problem is also significant. The largest type of agricultural pollution is sedimentation. In addition to erosion from agricultural lands, large quantities originate from stip mine and construction areas. Sediments cause damage directly by filling of lakes, ponds, and channels. This reduces reservoir capacities and also acts to reduce the water carrying capacity of streams. Sediments in surface water supplies increase water treatment costs and damage habitat of fish and aquatic life.

Sediments are usually composed of fine clay or collodial material high in organic matter, which carry adsorbed on their surfaces nutrients such as phosphorus and potassium, or organic chemicals such as pesticides. These materials, in water, act as pollutants or as nutrients for algae and aquatic plants. Phosphorus is largely carried from land surfaces by soil erosion and is an important cause of accelerated eutrophication of lakes. In addition to the pollution aspect of agricultural erosion, an economic loss occurs to the farmer. The eroded particles are often the most fertile and nutritive components of agricultural soils.

Organic pollution in the Basin waters has been a severe problem. In the past municipal wastes created more

biological oxygen demand (BOD) than any other source. Presently, municipalities are required to provide, as a minimum, secondary treatment. This treatment is intended to remove 85 percent of the BOD. Residences and other installaions not served by sewage treatment plants are contributing a share cf total organic pollution. Many of the systems are malfunctioning and research is underway to design more effective individual waste disposal systems.

Agriculture contributes to the organic pollution problem from several sources. Large quantities of waste are produced in livestock production. Much of the waste in the form of manures is spread over agricultural lands and occasionally, are washed from fields and feedlots. Plants and residue from agricultural crops in various degrees of decay also contribute to organic pollution. Even waters from forested lands are high in phosphorus and nitrogenous by products. Significant amounts of nutrient pollutants were entering streams before man began managing the lands.

Numerous fish kills have been reported throughout the Basin. Some kills have been attributed to high BOD concentrations which caused deficiencies in dissolved oxygen. Most kills resulted from chemicals, petroleum, or acid from coal mines. Steps have been taken to limit planned industrial dumpage and to minimize risk of accidental contamination. Agricultural chemicals used mainly as pesticides continue to be used widely throughout the Basin. These chemicals attach to small soil particles which are eroded and transported to the streams.

Acid is formed when, as a result of the mining process, iron disulfide (pyrite) is exposed to air and reacts with oxygen and water to form sulfuric acid and ferric hydroxide. The acid reacts with other minerals in the spoil. Calcium, magnesium, aluminum, and manganese are brought into solution and enter stream flow, along with sulfate and iron. Strip mining contributes large quantities of acid pollution since many acres have been mined in the basin. Deep mines which have not been sealed to prevent acid water from flowing into the streams create severe pollution problems in affected areas. Moxahala Creek may be the most acid polluted stream in the Basin.

Thermal pollution is a problem largely along the main stem of the Muskingum River. During peak production at thermal electric generating plants and times of low flow, (defined as seven-consecutive day low flow with recurrence interval of 10 years) temperatures will increase 16°F-25°F with complete mixing. Where complete mixing is not accomplished, temperature increases at certain river areas are considerably greater.

Pollution from various sources adversely affects the many water uses. To assure water quality the Board has established stream quality criteria for the following: agricultural and stock watering, recreation, aquatic life A, aquatic life B, industrial water supply, and public water supply. Water for agricultural uses is required to meet the following criteria:

1. Free from substances attributable to municipal, industrial or other discharges, or agricultural practices that will settle to form putrescent or otherwise objectionable sludge deposits.

2. Free from floating debris, oil, scum and other floating materials attributable to municipal, industrial or other discharges, or agricultural practices in amounts sufficient to be unsightly or deleterious.

3. Free from materials attributable to municipal, industrial or other discharges, or agricultural practices producing color, odor or other conditions in such degree as to create a nuisance.

4. Free from substances attributable to municipal, industrial or other discharges or agricultural practices in concentration or combinations which are toxic or harmful to human, animal, plant, or aquatic life.

Pollution caused by agriculture can have an adverse effect on growth of aquatic life A and B. Organic material from fields and feedlots that enter in streams add to the BOD. Sediment which contains nutrients, particularly phosphate, attached to the particles provide food for aquatic plant and algae growth. Growth of these types compete for the available oxygen. As oxygen content decreases, so do numbers of aquatic animals. Sediment also carries materials such as pesticides which are toxic to aquatic animals.

Industrial water supplies likewise must contain an established amount of dissolved oxygen. Dissolved solids cannot exceed 750 mg/l as a monthly average value, nor exceed 1,000 mg/l at any time.

The most restrictive stream quality criteria is for public water supply. Limits have been established for bacteria, odor, dissolved solids, radioactivity, and chemical constituents. Present controls on municipal and industrial polluters have improved the water quality considerably. More improvement is expected from existing controls. Malfunctioning septic tanks, organic agricultural pollutants, and sedimentation continues to be major problems.

Chapter 5

PRESENT AND FUTURE NEEDS FOR WATER AND RELATED LAND RESOURCES DEVELOPMENT

MUSKINGUM RIVER BASIN

Chapter 5. Present and Future Needs for Water and Related Land Resources Development

Present and Future Needs for Water and Related Land Resource Development

This section describes needs for development of water and related land resources. Many problems discussed in Chapter four are concerned with: flooding, erosion, recreation, water supply, environment, and water quality would be improved or eliminated by resource developments. Both structural and nonstructural measures are needed. These developments could improve standards of living and economic opportunities, and help provide for the personal well-being of people in the Basin.

To meet projected needs for food and fiber, considerable yield increases will be required. The Basin is capable of producing its share of the nations food and non-wood fiber needs in the future. Production of these commodities will require application of improved management and new technologies.

There is a need at national and local levels for development which would improve the efficiency of producing food and fiber in the Basin. Relevant possibilities for types of development to improve efficiency of production include: flood protection, drainage, irrigation, and land treatment.

A. Land Treatment

Proper application and maintenance of land treatment measures are the basic element for the conservation, utilization, and development of land, water, and related resources of the Basin. Preservation of the soil resource is essential to maintenance of the area's agricultural base. See Tables 5-1 and 5-2 for the estimated land treatment needs on open land of the Basin.

Land treatment programs should be based on use of each acre of land within its capability and treating each acre according to its physical needs to preserve its long range productivity. These programs are needed to assure a sound agricultural, water management program, and quality recreational and environmental developments. However, farmers cannot be expected to bear the cost of long range benefits to society when they must make short range

TABLE 5-1

Conservation Treatment Needs 1/
For Cropland By Hydrologic Sub-Basins
Muskingum River Basin, Ohio

Hydrologic Sub-Basins	Needs Crop Residue and Annual Cover	Needs Sod in Rotation	Needs Contouring	Strip Cropping Terraces or Diversions	Permanent Cover	Needs Drainage
			(Thousand Acres)			
1. Sandy Creek	2.3	10.3	4.0	21.8	1.6	14.8
2. Conotton Creek	1.9	8.3	3.2	17.4	1.3	11.8
3. Sugar Creek	2.3	10.3	4.0	21.8	1.6	14.8
4. Upper Tuscarawas	3.4	14.4	5.5	30.5	2.1	20.7
5. Stillwater Creek	2.8	12.4	4.8	26.1	1.9	17.7
6. Mohican River	5.6	24.8	9.6	52.2	3.8	35.6
7. Kokosing River	2.8	12.4	4.7	26.1	1.8	17.7
8. Killbuck Creek	3.7	16.5	6.4	34.8	2.5	23.6
9. Wills Creek	5.1	22.7	8.8	47.9	3.5	32.6
10. Licking River	4.2	18.6	7.2	39.2	2.8	26.7
11. Wakatomika Creek	1.4	6.2	2.4	13.1	1.0	8.9
12. Jonathan Creek	1.9	8.3	3.2	17.4	1.3	11.8
13. Wolf Creek	1.4	6.2	2.4	13.1	1.0	8.9
14. Muskingum (Local)	8.0	35.1	13.5	73.8	5.3	49.9
TOTAL	46.8	206.5	79.7	435.2	31.5	295.5

1/ Based on 1971 Ohio Conservation Needs Inventory.

TABLE 5-2
Conservation Treatment Needs 1/
For Pasture
Muskingum River Basin, Ohio

Hydrologic Sub-Basins	Needs Change In Land Use	Protection from Grazing	Improvement of Cover Plant	Brush Control	Reestablishment of Vegetative Cover	Brush Control and Reestablishment
1. Sandy Creek	3.8	1.7	15.3	5.9	2.3	4.7
2. Conotton Creek	3.1	1.4	12.3	4.7	1.9	3.7
3. Sugar Creek	3.8	1.7	15.3	5.9	2.3	4.7
4. Upper Tuscarawas	5.3	2.4	21.4	8.2	3.3	6.6
5. Stillwater Creek	4.6	2.1	18.3	7.0	2.8	5.6
6. Mohican River	9.1	4.2	36.7	14.0	5.6	11.3
7. Kokosing River	4.5	2.1	18.3	7.0	2.8	5.6
8. Killbuck Creek	6.1	2.8	24.5	9.4	3.7	7.5
9. Wills Creek	8.4	3.8	33.5	12.9	5.1	10.3
10. Licking River	6.8	3.1	27.5	10.5	4.2	8.4
11. Wakatomika Creek	2.3	1.1	9.2	3.5	1.4	2.8
12. Jonathan Creek	3.1	1.4	12.3	4.7	1.9	3.7
13. Wolf Creek	2.3	1.1	9.2	3.5	1.4	2.8
14. Muskingum (Local)	13.0	6.0	52.0	19.8	7.8	15.9
TOTAL	76.2	34.9	305.8	117.0	46.5	93.6

1/ Based on 1971 Ohio Conservation Needs Inventory

management decisions within the free market pricing system. Thus it will be necessary for society to provide incentive payments in the form of cost sharing to insure that the desired level of land treatment is achieved. Further discussion is in Chapter Eight.

B. Flood Damage Reduction

There is a need for flood reduction in the tributary watersheds where most flood damages occur. Flood reduction needs were studied in all hydrologic sub-basins. Economic evaluations indicate flood damage reduction is needed in all sub-basins.

Killbuck Creek, Sandy Creek, Mohican River and Stillwater Creek sub-basins have the greatest needs for flood reduction. Investigations revealed immediate action is needed to reduce flood damages. These actions should include floodwater retarding structures if economically feasible or some measures of flood plain management.

Feasibility studies were conducted for each sub-watershed. Upper Killbuck Creek Watershed revealed sufficient flood damages to justify development for flood prevention alone. Data from watersheds studied at earlier dates also indicate favorable benefits-cost ratios - See Chapter Seven for a listing. Further evaluations revealed that structural measures could be justifiable in areas where multi-purpose reservoirs were needed.

Future floodwater damages in some of the watersheds could be greatly reduced by local regulations to control the development of high damage installations in the flood plains. The scope of this study was insufficient in detail to determine feasibility of small local protection projects.

The flood plain lands need to be maintained for compatible forest, wildlife, and recreation, and limited residential and commercial development.

The Chippewa Creek Watershed is located on the upper reaches of the Upper Tuscarawas Sub-Basin. The works of improvement for the watershed are partially completed. When completed, these works of improvement will provide an estimated $88,900 reduction in annual floodwater damages.

C. Erosion Control

Erosion is best controlled and prevented through an organized plan of land treatment, involving use of cover crops and residues, contour planting and plowing, and other conservation techniques. Soils with inherent erosion problem due to slope or structure occur throughout the Muskingum River Basin and require land treatment measures to prevent accelerated soil loss by sheet, rill, or gully erosion. Soils with severe erosion problems occur on 557,986 acres within the Basin.

Severely erodible soils comprise 686,414 acres. According to the Conservation Needs Inventory dated 1971, erosion damage is now a problem on 109,000 acres in 63 small watersheds of less than 400 square miles drainage area in the Muskingum River Basin.

Wind erosion is not considered a problem in the Basin, but proper management is needed to conserve and protect 17,147 acres of soils which are characteristically susceptible to wind erosion.

Proper conservation practices can effectively decrease erosion. No-practice, misuse, or mistreatement can promote accelerated erosion and waste a valuable resource. Development of individual and group conservation plans is an effective means of combining the capabilities of soil and water resources with the needs of landowners and operators. Plans could then be established to convert some lands to more appropriate uses that are within their limitations and geared to their specific capabilities.

The Basin's forest resource has potential to adequately satisfy needs now and through the projection periods. Acreage of total forest land in the Basin is projected to increase slightly through the projection years, and the increase in population and outdoor activity will intensify the use of this acreage. To maintain the forest lands under increased use, additional watershed protection and an increase in the productive potential of the forests is necessary.

Exclusion of livestock grazing on 300,000 acres of grazed forest land and the planting of nonstocked or poorly

Contour strip cropping helps reduce runoff and erosion.

Proper land treatment on rolling land.

stocked forest will improve the hydrologic condition. Hydrologic condition of much of the Basin forest land could be improved from poor to fair or better. Included in this category is reduction of erosion on 32,000 acres of forest land considered in need of erosion control.

Table 5-3 includes the potential forest land treatment measures needed in the Muskingum River Basin.

Table 5-3

Forest Land	Acres1/
Grazing Control (fencing)	300,000
Planting	366,000
Timber Stand Improvement	1,066,500
Erosion Control Needed	32,000

1/ Some of these acreages overlap. Timber Stand Improvement may be done on areas being protected from grazing. Acreages are within hydrologic boundaries of the Basin. Computed from C.N.I. data.

D. Municipal and Industrial Water Supply Needs

Water requirements for manufacture of forest products vary by product and process and are largely confined to the production of paper and its allied products. Limited quantities of water are also used during the production of lumber and wood products. Lumber mills that produce five million board feet or more per year average about 1,000 gallons of water per thousand board feet of lumber produced. A mill of this size frequently uses log ponds to clean and move logs in the mill area. The average small mill uses 10 to 20 gallons per thousand board feet of lumber produced. If water is used to heat logs, a typical veneer plant may use 37 to 75 thousand gallons of water per vat per week. A total of 83 saw mills of varying sizes in the Basin use .06 mgd of water.

Manufacturers of pulp and paper require much more water in processing, and for residue disposal. Water needs vary with the pulping process used, and whether paper manufacture is integrated in the process. Amounts vary from a minimum of 1,000 gallons per ton of pulp for

ground wood process to 144,500 gallons for sulfate and soda processes. Most water used in processing may be recirculated in the mill, but finally returns to the stream as effluent either directly from the mill's own treatment plant or through municipal treatment plants. One pulp and paper mill in the Basin, using the sulphate process, uses seven mgd of water.

In 1960, 85 mgd were withdrawn from 115 public water supply systems. Fifty-five mgd came from underground aquifers (sandstone, bedrock and unconsolidated sand and gravel deposits of glacial origin) and 30 mgd from surface water. Forty-one percent of total water provided from public facilities was sold to private industries.

Privately owned industrial water supply systems withdraw very large quantities of water. Manufacturing plants withdraw 344 mgd and purchased 34 mgd from municipal supply systems. Power plants use 1,800 mgd.

About 90 percent of the water withdrawn by manufacturing plants in the Basin supplies industries for processing primary metals, chemical and allied products, and machinery, representing the three largest industrial water users. Eighty-eight percent of water withdrawn for industrial purposes was used for cooling.

Ninety-seven percent of total intake of public and private water withdrawal was reported returned to streams or underground.

Distribution of water withdrawal for municipal and industrial supplies (1960) is shown in Table 5-4. Also shown is the projected municipal water use for the 2000.

Table 5-4

Year	Municipal Water Use (mgd)	Industrial Water Use (mgd)	Pulp and Paper Mill Water Use (mgd)	Total M&I Use (mgd)
1960	84.912	2137.089	7.000	2229.001
2000	259.80	1/	1/	--

1/ Not available.

Increased development of groundwater resources should be promoted, especially in localities where a significant supply is available such as from unconsolidated valley fill deposits.

Reservoirs and wells are sources for providing water supplies satisfactory for public use.

Additional water supplies may be obtained from sewage treatment plant effluent when waste treatment techniques improve.

E. <u>Drainage Improvements</u>

There is a need for drainage systems on approximately 295,000 acres of cropland in the Basin if the production is to be maximized. Agricultural production can be improved on major areas of this land through application of surface and subsurface drainage systems. The drainage of these croplands could be an important factor in the Basin's economy.

Major portions of the drainage problem area requires individual and small group action. Larger group action is needed where adequate outlets is lacking.

Proper drainage of cropland could be a factor in preserving the soil resource. Intensive cropping of land with a wetness problem would decrease the need to intensively crop upland soils with an erosion problem. Drainage improvement measures would, therefore, be beneficial in controlling erosion and sediment.

F. <u>Irrigation</u>

Irrigation for agricultural purposes is quite limited in the Muskingum River Basin. Currently about 4000 acres are irrigated and used mainly for vegetable and potato crops. Generally the soils groups which comprise the majority of the Basin have properties not suitable for irrigation. The well drained Wooster-Canfield-Massillin soils located in Richland, Ashland, Wayne, and Stark counties and the gravelly terraces along the main streams do have possibilities for irrigation development. It is doubtful that many acres of these soils will be irrigated because of high average annual rainfall which occurs in the area and the types of crops currently raised.

Current trends show that the local production of specialty crops within the Basin is not increasing in relation to population growth; therefore, irrigation of specialty crops is not expected to increase substantially. Expanded demands for these specialty products in the urban population centers such as Akron and Cleveland are being met by production in other areas of the country having a more favorable climate and better growing conditions.

The projected economic conditions indicate that irrigation is not expected to increase sufficiently to warrant major consideration of land and water resource development before the year 2000. However, individual farms will continue or begin to irrigate selected soils and crops where it will provide an economic advantage.Management decisions of the individual landowners are based on availability of labor, capital, and soil and water resources. It is estimated 5,100 acres will be irrigated by 1980, and about 9,900 acres by 2000. This will require about 5,000 and 10,000 acre feet of irrigation water respectively, during the driest year. It is expected that a relatively small portion of the water will be from irrigation storage in reservoirs and that most will come from ground water or stream flow. In most areas, the storage of irrigation water in reservoirs is too costly for profitable operation. It is recognized that changing conditions might develop a potential for irrigation that is not presently foreseeable.

G. Water Quality

A primary objective for the future is to reduce pollution of the Basin's water resources. Reducing chloride concentrations in water in localized areas will be a main concern.

The need for pollution abatement in the Basin is greatest in the Tuscarawas and Muskingum Rivers from Barberton to Marietta. The primary need is to reduce the total amount of waste material, namely sodium, getting into the streams. A method which would allow the material to be reclaimed and reused in the manufacturing process is needed.

Of the 124 industrial establishments in the Basin, 31 are considered to have inadequate forms of waste treatment or discharge control.

Adequate conservation measures are needed to reduce erosion and sediment deposition in streams.

There is need to improve and control the application of commercial fertilizers, pesticides, herbicides, and insecticides to prevent harmful quantities from entering natural streams of the Basin

Waste material and spoil from strip mining should be disposed of by proper methods and should never be allowed to enter streams.

In many parts of the Basin, a need exists for the establishment of areas that can be used for the proper disposal of garbage and other waste. An education program to encourage the citizens of the Basin to use designated areas instead of streams and roadside ditches for disposing of waste materials will improve the amenity of the streams.

An effective method to reduce pollution concentrations in streams is to increase stream flows during seasonal "dry" periods. Reservoirs and wells are sources for low flow augmentation.

H. <u>Recreation</u>

As shown in the land and water based recreational inventory, the Muskingum River Basin is rich in existing recreation resources. The physical characteristics and proximity to highly populated areas provide an attractive area for enjoyment of recreational activities. As the population increases the demand for water and land based recreation areas will expand. Population increases, and therefore recreation demand, will be greatest in the northern counties. Additional demand will come from areas outside the Basin where supply of recreation water and land is insufficient to satisfy demand.

Much of the Basin area is highly suited for recreation usage. Many good sites remain which could be developed to

Livestock exclusion promotes regeneration of forestland and imprcvement of the hydrologic condition.

The need exists for development of additional multipurpose recreation and flood prevention reservoirs to meet future demands.

meet expanded water based recreation demand. Most good sites are in the southern two-thirds of the Basin within driving range from areas generating high demands. Lands surrounding the good sites are predominately forested. The trend in land use in recent years has been a reduction in intense agriculture and an increase in pasture, idle, and forests. This changed land use is accompanied by an increase in farmsteads being acquired mainly for weekends and summer retreats.

A report prepared by Stanley Consultants for the MREA Water Plan shows recreation demand projected for 18 of the MREA counties plus the spillover from three urbanized counties on the northern rim. The numbers shown in the Table below are acres projected to meet demands for boating, fishing, swimming and land based activities during the peak hour on a typical weekend (Table 5-5).

The demands from Medina and Summit counties above that which can be met by county resources are included in the Northeast Ohio spillover. All 19 counties of the MREA region except Perry are covered in the demands shown in Table 5-5. Perry County will more than meet its own needs and its acreage available less its needs will help absorb the demand shown in Table 5-5.

Table 5-5

Recreation Acreage Required in 18 Southeast Ohio Counties1/

Activity	1970	1980	2000	2020
Boating	32,927	42,700	60,100	77,900
Fishing	1,887	2,100	2,400	2,600
Swimming	332	400	610	820
Land Based Activities	50,880	83,300	148,100	218,100

1/ Includes spillover demand from Northeast Ohio to be met by Ashland and Stark Counties.

Source: Stanley Consultants Report furnished by ODNR to the Corps of Engineers, March 9, 1972.

Table 5-6 shows difference between acreage supplied and acreage demanded.

Table 5-6

Recreation Acreage Needed or Surplus in 18 Southeast Ohio Counties1/

Activity	1970	1980	2000	2020
Boating	+ 29,063	+ 19,500	+ 7,700	-10,000
Fishing	- 715	- 880	- 1,170	- 1,370
Swimming	- 120	- 218	- 424	- 632
Land Based Activities	+147,298	+112,900	+52,500	-17,000

1/ Surpluses are indicated by a positive sign and needs by a negative.

Source: Stanley Report furnished by ODNR to Corps of Engineers, March 9, 1972.

A surplus of boating and land based activity acreage is indicated through the year 2000. There is need for additional fishing and swimming acreage at present but the acreage needed is small compared to that needed for boating and land based activities after year 2000.

The Stanley Report indicates that more than half the supply of boating acres is contained in the river systems of MREA and that better access facilities must be provided. Needs for boating are greatest near the population centers in the northern part of the Basin. Both public and private institutions must share responsibility for providing or enhancing boating opportunities.

As with boating the greatest need for fishing is centered in the northern counties of the MREA region. The Stanley report states that the deficit for fishing can be met if access to streams and high water quality is assured.

Swimming needs include both pools and beaches. The Stanley report recommends the provision of additional beach and/or pool facilities at major recreation areas.

Land based recreation activities includes camping, picnicking and hiking. Both public and private agencies are expected to contribute to meeting the deficiency that may occur by 2020. Facilities should be located adjacent to a body of water for best use. The Stanley report states that in MREA facilities for land based activities can be provided as a part of flood plain protection and resource development programs.

In summary, the major areas of need are on the North Urban Rim of the MREA region.

Additional land required by 2020 is approximately 10,000 acres of water for boating, 1400 acres of shoreline for fishing, 600 acres of beaches for swimming and 17,000 acres of land for land based activities. Early action plans should provide about 900 shoreline acres and about 200 beach or pool acres. Boating acres and land based activity acres are not expected to be critical until after 2000.

Chapter 6

EXISTING WATER AND RELATED LAND RESOURCE PROJECTS AND PROGRAMS

MUSKINGUM RIVER BASIN

Chapter 6. Existing Water and Related Land Resources Projects and Programs

Introduction

A. Soil Conservation Service

B. Soil and Water Conservation Districts

C. Agricultural Stabilization and Conservation Service

D. Farmers Home Administration

E. Cooperative State-Federal Forestry Programs

F. Watershed Protection and Flood Prevention

G. Resource Conservation and Development

H. Federal and Local Protection Projects

I. State Development and Programs

J. Fish and Wildlife

K. Recreation

L. Water Quality

Existing Water and Related Land Resource Projects and Programs

Combined efforts of Federal and State agencies, local communities and individuals have developed the Basin's water and related land resources to its present status. Developments vary in size and purpose. They range from tree planting to constructing large reservoirs.

Several water resource developments are presently in use. Fourteen reservoir projects are operated by the Corps of Engineers and the Muskingum Watershed Conservancy District, two Federal reservoir projects, a major State reservoir project, five Federal local protection projects, and one State channel improvement project. Many smaller State and other lake projects are distributed throughout the Basin.

This section explains in some detail the USDA programs along with related Federal, State, and local agencies or programs that influence water and related land resource developments in the Basin.

A. Soil Conservation Service

The primary function of the Soil Conservation Service, under Public Law 46 of the 74th Congress, as amended, is to assist landowners, communities, and institutions in planning, applying and maintaining soil and water conservation measures on their lands. The Act was passed by Congress in April 1935. It formally recognized soil erosion as "a menace to national welfare" and declared a "policy of Congress to provide permanently for the control and prevention of soil erosion and thereby to preserve natural resources, control floods, prevent impairment of reservoirs, protect public health and public lands, and maintain the navigability of rivers and harbors."

Under this Act, the Soil Conservation Service provides technical assistance through soil and water conservation district programs. All counties in the Muskingum River Basin have organized soil conservation districts and are active in conservation program developments.

Related activities of SCS include soil surveys and interpretations, propagation of new conservation plant materials, and providing technical assistance in connection with other USDA programs. Watershed project are initiated through the PL-566 program and soil and water conservation district activities.

B. Soil and Water Conservation Districts

There is a Soil and Water Conservation District in each of the 27 counties included in the Muskingum River Basin. Each district, delineated by county boundaries, is organized or established under provisions of acts passed by State legislature to encourage development, improvement, and conservation of land and water.

Districts concern themselves with all water, land, and associated resource problems within their boundaries. Their main objectives are to have complete soil and water conservation programs established on all lands and to assist in the solutions of water problems throughout the districts. They enter into cooperative agreements with landowners and provide for assistance to those who wish to participate in the district program.

District programs include practices such as: farm planning for soil and water conservation; erosion and sediment damage reduction; and control of water including flood prevention, drainage, and irrigation. Among the many conservation and farm improvement practices applied and assisted by districts are 3,900 farm ponds and 97,208 acres of tree planting.

Districts prepare annual programs to meet goals and designate major problems and assistance needed to provide for the protection and preservation of land and water resources of the district.

Conservation practices applied as of July 1, 1972, for water and land resource developments that reduce erosion, sediment production runoff rates and control water are on the following page.

Practices	Unit	Amount
Conservation Cropping	Acres	793,610
Contour Farming	Acres	196,940
Stripcropping	Acres	320,740
Critical Area Planting	Acres	45,480
Diversion	Feet	1,657,100
Drainage Field Ditch	Feet	665,170
Drainage Main or Lateral	Feet	3,634,190
Grass Waterways or Outlet	Acres	2,610
Pasture and Hayland Planting	Acres	294,550
Pasture and Hayland Management	Acres	231,980
Terrace Gradient	Feet	158,660
Drain	Feet	54,009,090

Other conservation practices which provide for recreation and fish and wildlife areas and the amount of these installed practices are as follows:

Practices	Unit	Amount
Farm Ponds	No:	3,900
Fish Pond - Management	No:	3,470
Wildlife Wetland Management	Acres	5,080
Tree Planting	Acres	97,210
Cropland to Wildlife - Recreation	Acres	7,470
Woodland Improvement	Acres	54,800

The Soil Conservation Districts take leadership in guiding and scheduling programs to meet their needs.

C. Agricultural Stabilization and Conservation Service

The Agricultural Conservation Program is a program administered by the Agricultural Stabilization and Conservation Service that allows producers of agricultural products to participate with the Federal Government on a voluntary basis to install needed conservation practices on individual farms. This program provides cost-sharing assistance to farmers in implementing soil, water, woodland, and wildlife conservation practices on farm lands now in agricultural production. It does not apply to development of new or additional land for agricultural production. The cost of the conservation practice is

generally shared equally between the Federal Government and the cooperators. The conservation practices must be applied satisfactorily by the farmers in accordance with applicable specifications.

The Soil Conservation Service has responsibility for (a) helping to formulate the annual Agricultural Conservation Program and (b) carrying out certain of its technical phases. The Soil Conservation Service responsibilities for technical phases of applying specified ACP practices on the land includes the following steps:

1. Determination of need and practicability of the practice on a farm or ranch.

2. Necessary site selection, other preliminary work and layout of a practice.

3. Necessary supervision of installation.

4. Necessary checking and certification of performance.

D. Farmers Home Administration

The Farmers' Home Administration Act of 1946, under Public Law 731 - 79th Congress has been assisting, through loan programs, rural property owners and communities in the development of water and related land resource projects. Community Service loans and grants have been provided to legal entities for the development, distribution, use and control of water, installation of waste disposal, constuction of outdoor recreation improvements and soil conservation practices.

All counties within the Basin, with the exception of Belmont, Columbiana, Summit, Medina, and Richland, have F.H.A. Comprehensive Planning Grants. The grants assist in the preparation of county-wide comprehensive plans for the development of water and sewer systems for rural counties which do not have immediately available funds. There is one Soil Conservation Watershed loan for flood control -- The Chippewa Creek Watershed Project. Other Soil Conservation Watershed loans are made to legal entities for purposes such as: water storage, municipal water supply, and recreation.

Other programs include Direct Rural Housing, Insured Rural Housing, Farm Ownership, Operating, Emergency and Economic Opportunity Loans.

E. Cooperative State-Federal Forestry Programs

Cooperative Federal-State forestry programs active within the Basin include: Forestation, Forest Management, Insect and Disease Control, and Fire Control. The various services of these programs are provided by the Ohio Department of Natural Resources, Division of Forestry and Reclamation. Cost sharing is available from the Rural Environmental Conservation Program (RECP) through the Rural Environmental Assistance Program (REAP), and Forestry Incentives Program (FIP) for approved forest practices installed on private land. The Forest Service cooperates with the State and Corps of Engineers in multiple-use planning of public use areas and implementation of such plans on certain reservoir sites.

Over 94 percent of the commercial forest land is in private ownerships, and about two-thirds of these areas are in small holdings. Forest programs in which the State and the U.S. Forest Service cooperate are largely directed to helping these small, private forest, landowners plant, grow, protect, and market their timber. There is an estimated total of 16,450 forest land ownerships of which 14,460 are resident owners and 1,990 are absentee owners.

Many cooperative programs are well established and this represents some progress. During 1960-1969, 804 landowners received management planning assistance under cooperative forestry programs involving a total of 35,170 acres. Other accomplishments include: tree planting on 15,200 acres of open lands, stand improvement (including reinforcement planting) on 15,080 acres of forest land, improvement and controlled harvest cutting on 11,560 acres, and 8,920 acres protected from grazing. Under these programs, an additional 16,400 acres of tree planting, 18,200 acres of stand improvement, and 6,500 acres of grazing control are projected for completion by 1980.

Protection of forest land from destruction or damage by fire is necessary to attain maximum benefits for water, timber, recreational facilities, and wildlife habitat. Fires burn up the protective humus and duff layers and kill reproduction, which in turn leads to erosion of the bared soil and subsequent sedimentation and pollution of the streams.

Approximately two-thirds of the Muskingum River Basin lies within the boundaries of the Ohio State Forest Fire Protection Area (See Map 6-1). Fire control in the remaining one-third of the Basin is achieved by various county and municipal fire departments. On National Forest land adequate fire protection is provided by the U.S. Forest Service and Ohio State Forestry agencies under the Clarke-McNary Cooperative Fire Control Program.

During the last ten years, the yearly acreage of forest burned is 710 acres or 0.05 percent of forest land under state protection. This is well under the state fire-loss index goal of 0.1 percent of the protected area. The average size fire is two acres. Seventy percent of the fires occur in the spring, with the major causes debris burning and smoking. No reliable fire records are available for the Basin counties and portions of counties outside the state fire protection districts.

F. Watershed Protection and Flood Prevention

The Department of Agriculture provides technical and financial assistance for the development of small watershed projects for all types of water and land resource developments. Provisions for assistance include works of improvement for water management and flood prevention, protection and preservation of watershed land and forest, recreation or fish and wildlife development, and storage of water for municipal and industrial water supply and pollution abatement by flow regulations.

Map 6-2 shows status of small watershed project developments in the Basin. Application for assistance have been submitted on six areas by local people. These applications include a total land area of 1,219 square miles or 15 percent of the Basin area. Three of the applications have been authorized for planning. Two of these applications have been authorized for construction.

U. S. DEPARTMENT OF AGRICULTURE

MAP 6-1

FOREST FIRE PROTECTION

MUSKINGUM RIVER BASIN

OHIO

BASE LEGEND

BASIN BOUNDARY

COUNTY BOUNDARY

DRAINAGE

LAKE OR INTERMITTENT LAKE

DAM AND RESERVOIR

GLO TOWNSHIP LINE

2 OLD SEVEN RANGES

3 OHIO COMPANY PURCHASE

6 CONNECTICUT WESTERN RESERVE

7 U.S. MILITARY DISTRICT

8A CONGRESS LANDS EAST OF THE SCIOTO RIVER BY GREENVILLE TREATY

8C CONGRESS LANDS NORTH OF THE OLD SEVEN RANGES

10 DONATION TRACT

FOREST FIRE PROTECTION

FIRE PROTECTION AREA

SCALE 1/1,065,000

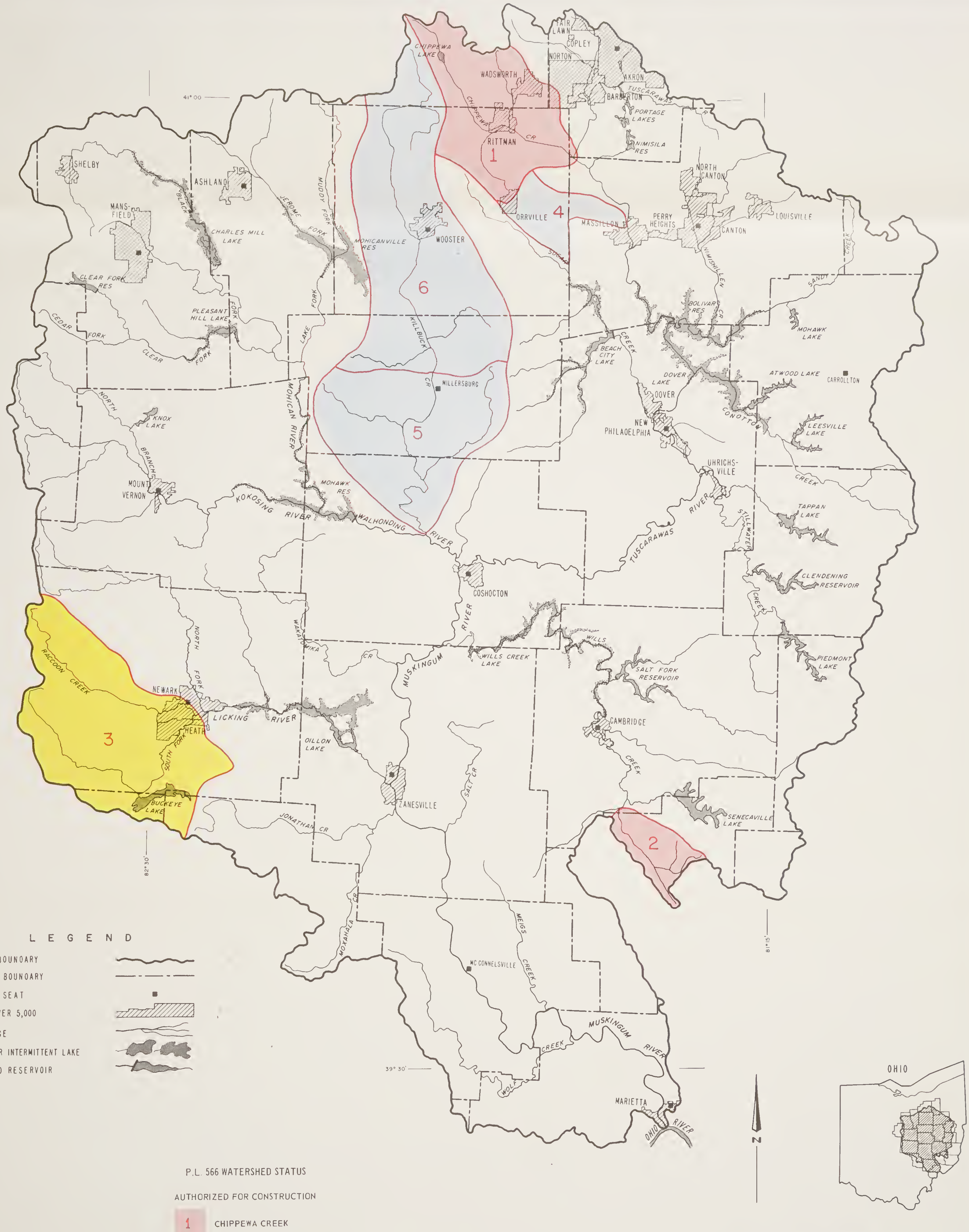
SCALE 5 0 5 10 15 20 MILES

SOURCE:
FAMILY OF MAPS SCS DRAWING NO.
5,R-32,783 (1-30-74) AND INFORMATION
FROM FIELD TECHNICIANS. TRANSVERSE
MERCATOR PROJECTION.

7-12-74
5,N-34,375

USDA-SCS-LINCOLN, NEBR. 1974

U. S. DEPARTMENT OF AGRICULTURE



L E G E N D

BASIN BOUNDARY
COUNTY BOUNDARY
COUNTY SEAT
TOWN OVER 5,000
DRAINAGE
LAKE OR INTERMITTENT LAKE
DAM AND RESERVOIR

P.L. 566 WATERSHED STATUS

AUTHORIZED FOR CONSTRUCTION

1 CHIPPEWA CREEK

2 BUFFALO CREEK

AUTHORIZED FOR PLANNING

3 SOUTH FORK LICKING RIVER

APPLICATION

4 NEWMAN CREEK

5 LOWER KILLBUCK CREEK

6 UPPER KILLBUCK CREEK

P.L. 566 WATERSHED STATUS

MUSKINGUM RIVER BASIN

OHIO

MAP 6-2

SOURCE: FAMILY OF MAPS SCS DRAWING NO. 5,R-32,783 (1-30-74) AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION.

USDA-SCS-LINCOLN, NEBR. 1974

9-12-74
5,P-34,377

The Chippewa Creek and the Buffalo Creek Watershed Projects are authorized for construction. The level of protection provided will be adequate for a substantial level of agricultural production and reduction in other flood water damages. Flood damages will be reduced $196,200 with projects installed.

G. Resource Conservation and Development Program

The Resource Conservation and Development (RC&D) Program was authorized by the Food and Agriculture Act of 1962. It expands opportunities for conservation districts, local units of government, and individuals to improve their communities in Multi-County areas. The Program can assist in enhancing their economic, environmental, and social well-being.

Projects are initiated and carried out by local people. Assistance is provided by state agencies and agencies of the United States Department of Agriculture under present program authorizations including that contained in Sections 31 and 32 (e) of Title III of the Bankhead-Jones Farm Tenant Act as amended by Title I, Section 102 of the Food and Agricultural Act of 1962 (Public Law 87-703), and the Soil Conservation Act of 1935 (Public Law 74-46). These projects will be planned and carried out in areas where there is need to accelerate conservation, development, and utilization of natural resources; improvement of the general level of economic activity; and enhancement of environmental and standard of living.

Two Resource Conservation and Development Projects are located partially in the Basin. The Buckeye Hills Project includes parts of the Belmont, Monroe, Morgan, Noble, and Washington Counties. The Crossroads Project includes only a part of Columbiana County. These projects have a completed plan and are authorized for operation.

Resource Conservation and Development Projects are initiated in areas where the acceleration of current conservation activities and the use of other authorities will provide additional opportunities to local people. The Soil Conservation Service, Forest Service, and other Federal agencies work with local communities and agencies in assisting project sponsors. At the present time, the Buckeye Hills Project is working on projects outside the Muskingum River Basin boundary.

H. Federal and Local Protection Projects

The Corps of Engineers and the Muskingum Watershed Conservancy District operate major reservoirs in the Basin. Local protection projects including levee and channel improvements are also planned and constructed by the Corps of Engineers.

The Basin has significant water resources development in use. In addition to 14 original reservoir projects operated by the Corps of Engineers and the Muskingum Watershed Conservancy District, there are two Federal reservoir projects, a major State reservoir project, five Federal local protection projects, and one State channel improvement project. Several smaller State projects and private lakes are located throughout the Basin.

I. State Development and Programs

Most of the flood control responsibilities for the State of Ohio are carried out by the Department of Natural Resources. Primary action of DNR has been to coordinate Federal, State, and local flood-control planning to assure orderly development.

The Basin has two State Forests - Blue Rock and Mohican-Memorial covering 4,573 and 4,061 acres, respectively. There are five State Parks - Blue Rock, Buckeye Lake, Mohican, Portage Lakes, and Dillon. The State Parks have combined land and water areas of 13,772 acres.

Nine state owned lakes are located in the Basin (See Table 6-1). Total water area is 8,684 acres.

The Ohio Department of Health, through the Water Pollution Control Board is responsible for abatement of pollution in waters of the State.

J. Fish and Wildlife

The Ohio Department of Natural Resources, Division of Wildlife is the state agency responsible for management of fish and wildlife resources and their habitats within Ohio.

Table 6-1
Inventory of State Projects
Muskingum River Basin, Ohio

Project	Date Build	Purpose	Location		Size		
			Sub-Basin	County	Area Acres*	Storage Ac.Ft.**	Drainage Area (sq.mi.)
Buckeye Lake	1832	Recreation	Licking River	Fairfield and Perry	2,853	19,940	49.2
Firestone Reservoir	1957	Water Supply	Tuscarawas River	Summit	50	490	34.7
Knox Lake	1953	Recreation	Kokosing River	Knox	495		31.0
Nimisila Reservoir	1942	Water Supply	Tuscarawas River	Summit	811	9,500	19.3
Portage Lakes	1830's	Water Supply, Recreation	Tuscarawas	Summit	1,198		
Summit Lake	1830's	Water Supply		Summit	90		
Zoar Lake		Recreation		Tuscarawas	30		
Salt Fork		Flood Control, Water Supply, Recreation	Wills Creek	Guernsey	F.C.-6,900 R.-3,000		160.0

* Flood control pool area shown includes recreation area.
** Flood control storage shown does not include storage for recreation pool.

Programs and projects carried out by the Division of Wildlife in the Muskingum River Basin and throughout Ohio involve basically five major phases of fish and wildlife management: (1) administration, (2) research, (3) management, (4) development, and (5) public relations.

Division of Wildlife administrators establish work priorities and basic work plan objectives for research projects and the management of public hunting and fishing areas. They also coordinate the agency's activities with federal, local, and other state agencies regarding fish and wildlife programs.

Fish and wildlife research entails design and completion of well-planned projects to obtain important information about game species of fish, birds, and mammals. This research seeks information on reproduction, average life spans, preferred foods, ecological relationships, and many other subjects. Such information helps biologists to determine factors which limit fish and wildlife population increases.

Good research programs generate information on which recommendations can be based for developing management plans. Such plans often deal primarily with establishing or improving suitable fish and wildlife habitat (quality food, shelter, and water for the given species). Management, based on sound research, also includes the setting of biologically sound hunting and fishing seasons and bag and creel limits.

Management plans lead to development of fish and wildlife areas. Development includes activities such as aquatic weed control, installations, and clearings in forests, food plots, access trails, and roads for hunters and fisherman, and tree-shrub plantations which provide wildlife food and cover.

The last basic phase of wildlife management involves compilation and distribution of information on radio, television, and in various publications. An effective information program is vital to explain projects and programs to the public.

K. Recreation

Many of the finest public recreational areas in Ohio are in the Muskingum River Basin. Water-oriented recreational facilities are always the most popular and practically all the recreation areas in the Basin are in this category. The Basin has about 740 bodies of water two acres or more in area. These include the recreation pools at most of the flood control reservoirs, smaller impoundments, abandoned quarries and gravel pits, and farm ponds. There are about 33,870 surface acres of water bodies at 43 public recreational areas in the Basin. Boating, fishing, camping, and hunting are permitted at most of the sites.

L. Water Quality

The Ohio Water Commission has primary responsibility for designating the department, regional office, or independent agency accountable for coordinating, planning, monitoring, and controlling water quality in the Muskingum River Basin. Resources development, as of 1968, was divided among a number of agencies, and none were staffed or equipped with the engineering, laboratory, or administrative responsibilities for water quality management. However, there are proposed water quality objectives.1/ These objectives are as follows:

1. Establish water quality monitoring stations and collect data for present and future control activities.

2. Work with the Department of Health to inventory and categorize all industries in the Basin.

3. Act with the Department of Health to define and enforce control of major pollution sources as immediate relief to Basin quality conditions.

4. Serve as liaison with the U.S. Army Corps of Engineers, Soil Conservation Service, and other agencies to coordinate improvement of natural pollution conditions.

1/ Objectives taken from the Muskingum River Basin Surface Water Quality Report.

5. Define management aids needed for future quality control such as a water quality, flood control, and low-flow augmentation basin model to facilitate projecting and programming specific control measures.

Chapter 7

WATER AND RELATED LAND RESOURCE DEVELOPMENT POTENTIAL

MUSKINGUM RIVER BASIN

Chapter 7. Water and Related Land Resource Development Potential

A. Availability and Use of the Land Resource Base
  1. Agricultural Land Base
  2. Nonagricultural Land Base

B. Land Treatment

C. Water Resource Development Opportunities
  1. Flood Control
    a. Hydrologic Soil Conditions
    b. Impoundments
    c. Channel Modifications
  2. Drainage Improvements
  3. Irrigation
  4. Water Quality Improvement
  5. Municipal and Industrial Water Supply

D. Recreation

E. Fish and Wildlife

F. Forest Resource Development Potential

A. Availability and Use of the Land Resource Base

Future land uses are based on projected requirements for food, feed, fiber and land requirements for nonagricultural purposes such as urban and related uses. Present and projected land uses are shown in Table 3-9 and 9A of Chapter 3.

Agricultural Land Base

Approximately 2,495,440 acres (USDA Classes I, II and III land) are suitable for regular cultivation. Cropland use accounts for 1,498,580 acres or 60 percent. Remaining 40 percent is used for forest, pasture and other noncultivated uses. Some of this acreage could be made available, if needed, for cultivated crops.

Another 967,940 acres are suitable for occasional or limited cultivation only (USDA Class IV land). Presently, 244,480 acres are in cropland use and a portion of the remaining 723,460 acres could be available for cultivation with appropriate land treatment practices applied.

The projected increase in population will cause an increase in demand for agricultural products. The Basin has potential to increase its crop production. This could be accomplished by: converting about 50 percent of the 407.5 thousand acres of pastureland on Classes II and III lands to crops, utilizing idle lands on Classes II and III, applying needed land treatment measures, and utilizing improved methods of technology.

Nonagricultural Land Base

As population increases, more land for urban and other nonfarm uses will be required. Land for these uses will come primarily from areas now in agricultural uses. Diversion of agricultural lands may be caused by inconvenience, ordinances, speculative ventures, tax structure and other factors related to developing urban areas. Ohio voters at the general election in November 1973 voted in favor of Issue No. 1 that amended the Constitution "to allow land devoted exclusively to agricultural use to be valued for taxation at its current value for such use." In April 1974, the Ohio General Assembly passed a

law implementing the constitutional amendment.1/ This law encourage agricultural land to stay in production rather than be converted to other uses because of the possible tax advantages.

By 1980, an estimated 69,370 acres of land presently being used for cropland and pasture will be required for urban and associated uses. Additional acreages required during the periods 1980-2000 and 2000-2020 are estimated at 115 thousand and 151.5 thousand acres respectively. By the year 2020, the amount of urban and other nonagricultural acreage, excluding forest land, is projected in excess of 668.5 thousand acres.

Surface mining operations have and will continue to have a tremendous impact on land use patterns in the Basin. To date more than 185,000 acres have been disturbed by stripmining operations. This practice is expected to continue at an annual rate of nearly 5000 acres until an additional 250,000 acres are disturbed by the year 2020 for a total of over 410,000 acres that will be surface mined. Fifty-seven percent of the acres to be mined will come from forest land and about 41 percent will be acres presently producing food, feed and fiber.

B. Land Treatment

Objectives of applying conservation measures are to reduce soil losses to a tolerable limit, solve water management problems, and establish desirable vegetation for the intended land use. The measures consist of a variety of individual practices (in many cases two or more practices on the same acre) designed to adequately protect the soil, water, and plant resources from deterioration either naturally or by the action of the land user.

Usually soil losses in excess of 3 tons per acre per year of on-site erosion are considered excessive. Estimates of soil loss on cropland soils without treatment range from 4 tons to over 12 tons per acre per year. For most soils in the Basin, proper treatment reduces the on-site soil loss to less than 3 tons per acre per year.

1/ Agricultural Use Value Taxation of Ohio Farms, Cooperative Extension Service, Ohio State University, January 1975, p. 2.

Erosion in cornfield without proper land treatment measures.

Grassed waterway to help reduce runoff and erosion.

Water management practices generally reduce water velocity to a nonerosive level and provide air-water relationships in the soil that support adequate plant growth. High crop yields and high residue production are favorable to sustained agricultural yields and at the same time provide a major food supply to many species of upland wildlife. Installation of all the subsurface drainage measures needed in the Basin would result in increased production of food, feed, and fiber on 295,000 acres. In addition, proper management of wetlands would improve the wetland habitat on about 50,000 acres.

Ponds create aquatic habitat for fishes, frogs and other aquatic vertebrates and invertebrates as well as nesting areas and resting areas for waterfowl. The area around these ponds is planted to grasses, shrubs, and trees that provides improved habitat for upland game. Stripcropping and hedge row plantings will provide many miles of valuable edge. These practices together with specific wildlife management practices would improve the upland game habitat on over 75,000 acres.

There is practically no limit to the potential for application of conservation treatment measures in the Basin. Over 3.3 million acres now require treatment to obtain maximum moisture infiltration and minimize erosion. Treatment of these acres would provide impacts in reduced surface runoff, increased crop yields, reduced soil erosion and sediment pollution of surface waters, increased wildlife habitat, and improved esthetics.

C. Water Resource Development Opportunities

1. Flood Control

a. Hydrologic Soil Conditions

Hydrologic conditions can be improved by treating critically eroding areas in the Basin. There is opportunity to treat these areas by tree planting, installing drainage measures, reducing grazing, and reestablishing vegetative cover. Stripcropping and constructing terraces and diversions will aid in improving hydrologic conditions. Increasing vegetative cover and application of conservation

practices for water management will increase infiltration characteristics of the soil. Improved land cover conditions and land use changes can reduce peak flow characteristics, reduce surface runoff, and improve quality of surface water. The amount of reduction of surface runoff and peak discharges depends on the antecedent soil moisture conditions and the intensity of storm rainfall.

Sediment pollutes streams, reduces channel and reservoir capacity, promotes increased flood stages, deposits on prime agricultural lands, fills drainageways, and damages urban facilities. Adequate conservation programs on agricultural lands help reduce sediment production by controlling erosion at its sources. Other sediment sources include new urban and suburban construction areas for which erosion control practices such as quick seeding of denuded and disturbed areas and temporary sediment stilling basins need to be applied. Probably the most effective means to protect denuded and disturbed areas of construction from accelerated erosion and subsequent offsite sedimentation would be to have legislative controls. Senate Bill 305, enacted January 1972, authorized the Ohio Department of Natural Resourrces, Division of Soil and Water Districts, to implement agriculture pollution and urban sediment pollution abatement programs. At the present time, the two programs have been formulated but have not been implemented. Legal controls now exist in promoting early reclamation of strip mine areas.

The Ohio strip mine law requires all stripped land to be seeded to legumes and grasses after operations have ceased. Temporary vegetative cover on soil storage areas is also required. A mixture of two varieties of grass seed and two varieties of legumes at a rate of 20-30 pounds per acre is recommended. Trees may also be planted along with grass cover.

b. Impoundments

Water reservoirs can be constructed in almost all areas of the Muskingum River Basin except for the relatively flat portions along the western and northern edges. Present and future needs of the Basin will have to be met with the use of smaller sites because the larger sites have been used by the Corps of Engineers and State of

Single-purpose floodwater retarding reservoir, Chippewa Creek Watershed.

Multiple-purpose impoundment, Leesville Reservoir.

Ohio for flood control and recreational developments. Several such sites, Buckhorn and Mohawk Lakes, have been used by private interest groups.

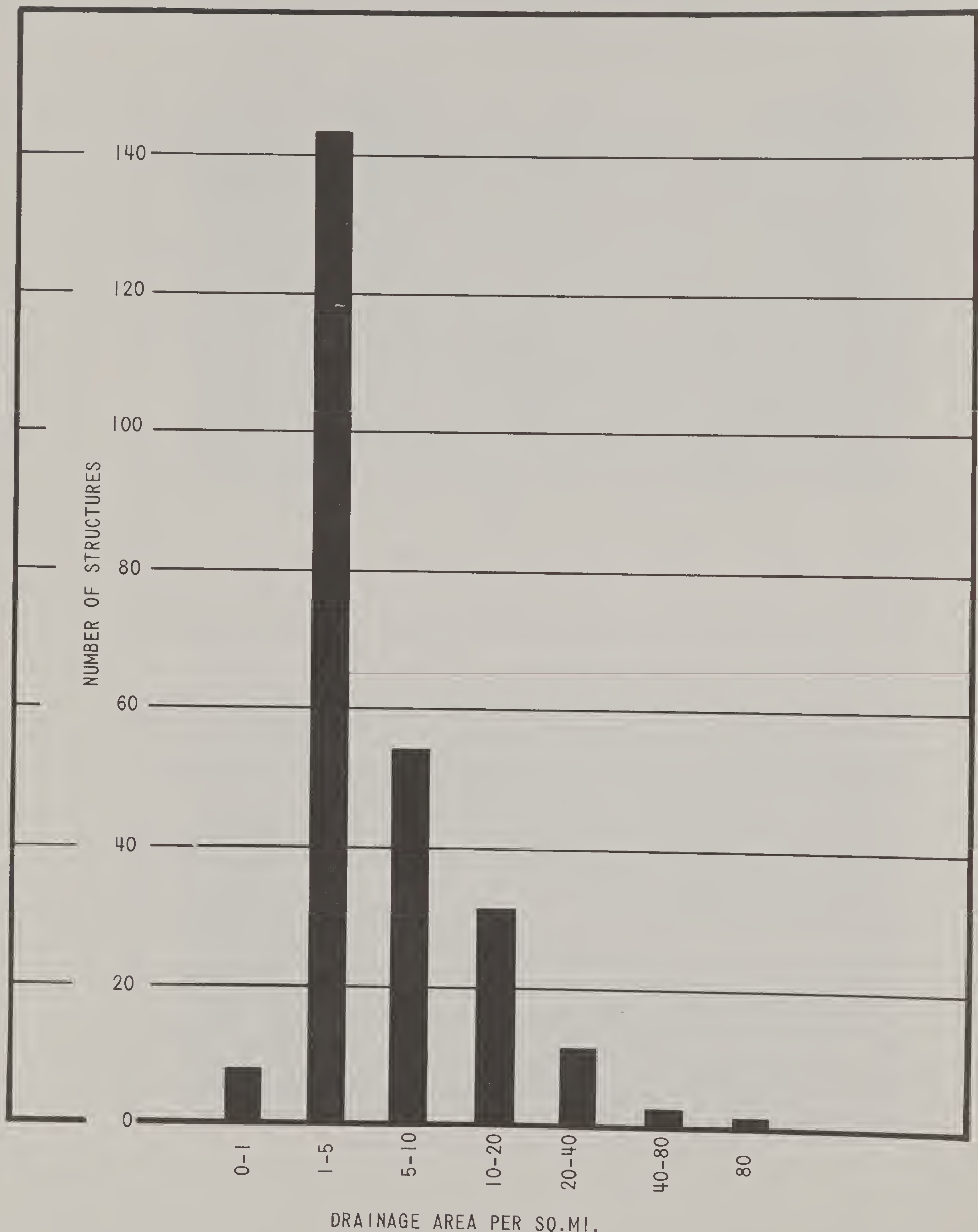
Three hundred and thirty-one potential dam sites were identified in this study. Of these, two hundred and forty-eight were found to have some degree of development capability. Drainage areas in these upstream sites ranged from less than one to greater than 80 square miles, as indicated by Figure 7-1. These identified sites do not necessarily reflect all possible alternate locations. Many of the sites have not had geologic investigations and may not be physically feasible because of adverse subsurface condition. The larger and more feasible sites are shown in Map 7-1. A preliminary evaluation and site map are shown in the appendix.

The rugged topography of MLRA 126 is well suited for reservoir development. Because of many other uses of the valley, such as roads, railroads, residential and industrial developments many larger potential sites are very costly. Many smaller less costly sites still exist. Many uses, namely flood control, sediment control, water supply, recreation, water quality control, and fish and wildlife developments are available in the smaller sites. The small sites can best be developed by a farm-by-farm approach or by small groups.

Few sites are available in MLRA 111 because the topography is generally not well suited for reservoir development. Most of the reservoir sites evaluated are located in the mid-section of the watershed. (MLRA 124 and 139)

Topography in MLRA 139 features low to moderate rolling hills consisting of glaciated material comprised mostly of sandstone and shale. MLRA 124 has steeper rolling hills which consist of residual sandstone and shale material. The valleys are generally wider than those in MLRA 126 and, consequently, are not used as extensively for roads, railroads and other municipal and industrial developments. The greatest concentration of sites are in the Lower Killbuck and Sugar Creek region. The sites in the Killbuck, Sugar Creek, Upper Tuscarawas, Sandy and Conotton Creeks are located within a 50 mile radius of the large metropolitan areas of Canton and Akron. The

Figure 7-1
RANGE IN DRAINAGE AREA SIZE
OF POTENTIAL RESERVOIR SITES



POTENTIAL RESERVOIR SITES
MUSKINGUM RIVER BASIN
OHIO

MAP 7-1

SOURCE: FAMILY OF MAPS SCS DRAWING NO. 5,R-32,783 (1-30-74) AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION.

USDA-SCS-LINCOLN, NEBR 1974

9-12-74
5,P-34,378

larger multi-purpose sites such as 4B-3.5-2 and 4A-12-3.2 have a potential development for recreational use which would serve the large number of people located on the northern rim of the Basin. Recreation provided at the sites would vary from boating, fishing to swimming.

Multi-purpose reservoirs in the proper locations within a region could be developed for low flow augmentation for water quality control. Flows and storage needs for 14 villages are shown in Table 7-2.

The required storage shown in Table 7-3, can be provided by the installation of multi-purpose reservoirs above the villages. For example, the required 6800 ac./ft. of storage for Ashland can be provided by structures 4B-1-2.1 and 4B1-2.5; and the 100 ac./ft. of storage for Jewett can be provided by structure 4A-11.1-1.

Total available storage in the reservoirs studied varied from three inches of runoff from the drainage area to an excess of forty inches. Majority of the sites studied have storage capacity for multiple purpose use. The studied sites vary in size from 205 acres to 66,560 acres and provide 245,416 acre feet of storage for flood control. Table 7-1 shows potential storage capacities of the various types of structures available in each hydrologic subarea. The list includes the most probable selections where data on alternate sites permitted a choice.

Two hundred and thirty-three of the 248 sites inventoried have sufficient storage for flood prevention and additional capacity for such purposes as recreation, water quality control, water supply, fish and wildlife, or irrigation. The 248 sites could provide 1,169,830 acre feet of water storage, with a surface area of about 59,184 acres. Total drainage area of these sites is about 1,731 square miles or 22 percent of the Basin. The storage available is not enough to greatly affect the total flooding problem in the Muskingum but some local flooding problems can be solved with a given reservoir. An economic study of each particular site is required to determine if a reservoir is a feasible answer to a flooding problem. No detailed economic analysis was completed for the reservoir sites studied in this report.

TABLE 7-1
Summary of Potential Sites Inventories
Muskingum River Basin, Ohio

Hydrologic Subarea	Site Inventoried (Number)	Drainage Area Sq. Mi.	Potential Storage Capacity			Permanent Pool Surface At Maximum Development (Acres)
			Sediment Ac./Ft.	Flood Prevention Ac./Ft.	Other Uses Ac./Ft.	
Mohican River	25	258.54	5,230	42,018	119,360	8,248
Killbuck Creek	44	250.53	5,899	34,622	163,640	7,237
Sugar Creek	25	93.37	3,081	12,337	8 ,940	4,431
Upper Tuscarawas River	3	13.81	349	2,824	10,142	841
Sandy Creek	11	135.75	3,471	20,167	101,440	7,182
Conotton Creek	5	41.61	2,558	5,806	2,594	1,302
Stillwater Creek	6	59.90	3,434	8,265	61,318	2,991
Wills Creek	14	99.12	4,024	12,671	71,092	3,467
Wolf Creek	11	152.50	10,441	15,312	90,393	4,663
Licking River	36	195.08	7,488	28,104	85,089	6,076
Moxahala-Jonathan Creek	15	127.40	8,576	20,638	110,093	5,755
Kokosing River	21	88.73	2,618	10,628	60,388	3,272
Wakatomika Creek	7	91.10	6,465	14,460	84,218	3,179
Local Drainage	25	123.52	3,698	17,564	128,123	540
TOTAL	248	1,730.96	67,332	245,416	1,169,830	59,184

TABLE 7-2

Flow Augmentation for Water Quality Control

Problem Area	County	Treatment Required 1/ (Percent)	Total Streamflow Required (CFS) 1980	2000	2020	Estimated Storage Required Acre Feet	Watershed	Estimated Storage Available
Ashland	Ashland	95	7.2	10.1	15.7	6,800	Lake Fork	20,402
Brewster	Stark	90	4.0	4.2	4.4	100	Sugar Cr.	8,965
Cambridge	Guernsey	90	6/	6/	12.0	100	Crooked Cr.	6,925
Canton	Stark	85	41.0	57.0	85.0	14,300	Nimishillen	17,450
Chesterhill	Morgan	90	0.4	0.6	0.8	600	Wolf Cr.	23,436
Creston	Wayne	90	6/	1.3	1.7	350	Chippewa Cr.	2,790
Granville	Licking	90	1.7	2.4	3.4	200	Raccoon Cr.	8,006
Jewett	Harrison	90	0.4	0.4	0.5	100	Conotton Cr.	3,344
Johnstown	Licking	90	2.0	3.1	5.3	1,700	Raccoon Cr.2/	2,448
Massillon	Stark	95	6/	6/	90.0	200	Newman3/	1,728
							Sippo Cr.	3,675
New Concord	Muskingum	90	1.0	1.4	1.8	400	Crooked Cr.4/	4,161
Shelby	Richland	90	5.8	7.7	10.0	1,700	Black Fork	18,548
Smithville	Wayne	90	1.5	2.3	3.5	860	Sugar 5/	0
Wooster	Wayne	90	29.0	37.0	50.0	2,500	Killbuck	26,614

1/ Percent BOD removal if low flow augmentation is provided.

2/ Also provide low flow augmentation for Granville (Licking County).

3/ Also provide low flow augmentation for Dalton (Wayne County).

4/ Also provide low flow augmentation for Cambridge (Guernsey County).

5/ Also provide low flow augmentation for Brewster (Stark County).

6/ Existing streamflow adequate

TABLE 7-3
Possible Plans for Future Water Supply
Muskingum River Basin, Ohio

Municipality	1960 Source[a]	Water Use (MGD) 1960	1975[b]	2000[b]	Possible Plans and Sources for Additional Supplies
Ashland County					
Hayesville	None	NMS[c]	0.02	0.03	Reservoir on Oldtown Creek, Mohican River Watershed, Site 4B1-2(13+)
Loudonville*	Wells	0.23	0.36	0.63	Pleasant Hill Reservoir
Mifflin	None	NMS	0.01	0.02	Charles Mill Reservoir
Perrysville	Wells	0.06	0.10	0.17	Pleasant Hill Reservoir
Belmont County					
Barnesville*	Surface	0.53[d]	0.82	0.87	North Fork Captina Creek
Carroll County					
Dellroy	None	NMS	0.01	0.02	No sites, consider wells
Leesville	None	NMS	0.01	0.02	Leesville Reservoir
Sherrodsville	None	NMS	0.02	0.03	No sites, consider wells
Columbiana					
Hanoverton	None	NMS	0.02	0.02	No sites, consider wells
Coshocton County					
Conesville	None	NMS	0.02	0.02	No sites, consider wells or Muskingum River
Nellie	None	NMS	0.01	0.01	Wells
Plainfield	None	NMS	0.01	0.02	Wills Creek Reservoir
Fairfield County					
Millersport	None	NMS	0.06	0.12	Buckeye Lake
Guernsey County					
Cumberland	None	NMS	0.03	0.03	Reservoir on Collins Creek, Wells Creek Watershed Site 4C-72(31-2)

Table 7-3 cont'd

Municipality	1960 Source[a]	Water Use (MGD) 1960	1975[b]	2000[b]	Possible Plans and Sources for Additional Supplies
Guernsey County cont'd					
Fairview	None	NMS	0.01	0.01	Crooked Creek, Skull Fork Watershed, Direct Drainage Site 4A-6(4+)
Lore City	None	NMS	0.01	0.02	No sites, consider wells
Old Washington	None	NMS	0.03	0.04	No sites, consider wells
Salesville	None	NMS	0.01	0.01	No sites, consider wells
Senecaville	None	NMS	0.04	0.04	Senecaville Reservoir
Harrison County					
Deersville	None	NMS	0.01	0.01	No sites, consider wells
Holmes County					
Holmesville	None	NMS	0.03	0.04	Coffee Run, Killbuck Creek Watershed, Site 4B-3.5(23)
Knox County					
Brinkhaven	None	NMS	0.01	0.01	Mohican River
Martinsburg	None	NMS	0.01	0.02	Big Run, Kokosing River Watershed Site 4B-4.2(2)
Mt. Vernon	Wells	1.96	2.82	4.28	Upper Kokosing River Watershed, Sites 4B-4.1(21+), 4B-4.1(9), 4B-4(20)
Licking County					
Alexandria	None	NMS	0.05	0.06	Upper Kokosing River Watershed, Sites 4B-3.1(3), 4B-3.1(4)
Gratiot	None	NMS	0.01	0.02	Moxahala-Jonathan Watershed, Site 4-9(4)
Hanover	None	NMS	0.01	0.03	Dillion Reservoir
Hartford	None	NMS	0.03	0.06	No Sites, consider Licking River
Kirkersville	None	NMS	0.03	0.07	South Fork Licking River Watershed, Site 4D-3(2)
Newark	N. Fork Licking River	11.70	21.1	46.6	South Fork Licking River Watershed, Sites 4D-4.1(1), 4D-3(4), 4D-3.1(5)

Table 7-3 cont'd

Municipality	1960 Source[a]	Water Use (MGD) 1960	1975[b]	2000[b]	Possible Plans and Sources for Additional Supplies
Morrow County					
Chesterville	None	NMS	0.01	0.02	South Branch Kokosing River, Sites 4B-4.1(2), 4B-4.1(5)
Sparta	None	NMS	0.01	0.02	Upper Kokosing River Watershed, Site 4B-4.1(4)
Muskingum County					
Adamsville	None	NMS	0.01	0.01	Symmes Creek, Direct Drainage, Site 4-10(1+)
Fultonham	None	NMS	0.01	0.02	Symmes Creek, Direct Drainage, Site 4-10(7)
Norwich	None	NMS	0.01	0.02	No sites studied, consider wells
Medina County					
Wadsworth	Wells	.777	1.99	4.68	No sites studied, consider wells
Perry County					
Glenford	None	NMS	0.01	0.02	Wise Run, Moxahala-Jonathan Watershed, Site 4-9(6)
Richland County					
Ontario*	None	NMS	0.56	1.26	No sites studies, consider wells
Shelby*	Reservoir	1.30	2.36	5.35	Black Fork, Mohican River Watershed, Site 4B1-4(3)
Stark County					
Hartville*	None	NMS	0.12	0.24	Nimishillen Creek, Sandy Creek Watershed, Site 4A-12.2(5)
Summit County					
Clinton	None	NMS	0.10	0.20	No sites studied, consider wells

Table 7-3 cont'd

Municipality	1960 Source[a]	Water Use (MGD) 1960	1975[b]	2000[b]	Possible Plans and Sources for Additional Supplies
Tuscarawas County					
Port Washington	None	NMS	0.04	0.06	No sites studied, consider wells
Rosewell	None	NMS	0.03	0.05	Beaverdam Creek, Direct Drainage, Site 4A-8(1)
Stone Creek	None	NMS	0.01	0.01	No sites studied, consider wells
Zoar	None	NMS	0.01	0.02	No sites studied, consider wells
Wayne County					
Burbank	None	NMS	0.02	0.03	No sites studied, consider wells
Congress	None	NMS	0.01	0.02	Shade Creek, Killbuck Creek Watershed, Site 4B-3.5(4)
Mt. Eaton	None	NMS	0.02	0.03	North Fork Sugar Creek Watershed, Sites 4A-10(6+), 4A-10(8)
Orrville	Wells	0.86	1.57	3.54	Sugar Creek Watershed, Sites 4A-10(3), 4A-10(4A)

* Communities with populations of 1,500 or more in 1970.
a. Data from 1960 municipal questionnaire.
b. Estimates of future needs are based on population growth record.
c. No municipal supply.
d. Water supplied from outside basin.

c. Channel Modification

There is some potential for channel modification in the Basin. The amount of control achieved by floodwater retarding structures will determine the amount of channel work needed. Highly erosive soils and steep stream slopes of the Basin will also limit potential development.

The full potential of channel work is usually attained in combination with floodwater retarding reservoirs. Some deepening of the channel may occur where inadequate drainage outlets are a problem. Channels designed for three year level of protection are considered adequate for agricultural purposes.

2. Drainage Improvement

As indicated in Chapter four, a problem of excessive moisture exists on about 295,000 acres of cropland. Based on the profit maximizing linear programming model about 214,000 acres would be profitable to drain at 1972 price relationships. (See Table 8-18) This constitutes an opportunity for improvement and could be accomplished by either open ditches or subsurface drainage, providing suitable outlets are available. Subsurface drains are more expensive to install but do not take land out of production as do open ditches. If well planned and constructed, subsurface drains require little maintenance.

Investigations indicate outlets for subsurface drains are somewhat limited. This factor combined with the relatively high cost has caused drainage improvements to occur at a slow rate.

3. Irrigation

Irrigation opportunities, based on physical potentials, are good in the northern portions of the Basin. There appears to be an adequate supply of ground wat . available for this use. At present, there are approximately 4,000 irrigated cropland acres within the Muskingum Basin.

Additional acres have not been utilized for irrigation due to several factors. The most significant of these

factors are: (a) prices of irrigable crops have not been high enough to justify the large capital investments in equipment and water supplies and (b) limited acreage of irrigable soils.

The 1971 Conservation Needs Inventory indicates no great change from dry crop farming to irrigated within the coming decades.

4. Water Quality Improvement

The major water pollutants within the Basin are caused by discharges from municipal and industrial uses. However, sediment from agricultural lands, adds greatly to the water pollution problems. In addition to erosion from agricultural lands, large quantities originate from strip mine and construction areas. Forest land erosion rates are low and offer few problems. The opportunity to improve water quality is dependent on vigorous programs to control soil erosion and to insure that existing water quality standards are met by municipal and industrial organizations.

The Water Control Board of the Ohio Department of Health can provide guidance in improving operation and maintenance of municipal and industrial sewage treatment plants. Systematic collection and disposal of garbage offers another opportunity to counties, towns and communities of the Basin in preventing stream pollution from solid waste materials.

Application of agricultural pesticides, herbicides and chemical fertilizers can be managed to minimize pollution of streams. Conservation practices that increase intake of water into the soil and reduce the rate and amount of runoff water that reaches streams can bring further reduction to pollution from agricultural sources.

Based on projected demand increases for water recreation and municipal and industrial uses, a program to reduce pollution in the Muskingum and its tributaries is a necessity. Table 7-2 reflects the water quality needs as presently assessed and projected with possible reservoir sites with the potential for meeting the needs. While

lack of water quality standards and funding for construction makes immediate or early action difficult, any long range plan should include these potential sites.

5. Municipal and Industrial Water Supply

Opportunity for M&I water supply development in the Basin is based on present and projected community use and sources. Some 45 communities in the Basin have no municipal water supply. The Water Inventory of the Muskingum Basin indicated the combined municipal water requirements of these communities will be 1.53 and 2.45 million gallons per day in 1975 and the year 2000 respectively. Many other communities with surface and well sources will increase useage as population increases. Multi-purpose reservoirs can help provide the additional municipal water supply needed to meet future demands. Table 7-3 shows communities with no municipal water supply and their projected requirements. The Table also shows possible reservoir sites which could aid in providing municipal water sources for these communities.

The Ohio Department of Natural Resources conducted a water inventory of the Muskingum River Basin in 1968. This inventory report contains information on present use and projected municipal water for cities and small communities situated within the Basin. Most small communities in the Basin obtain their water supplies from wells. Many can continue to do so through the year 2000 and beyond. However, those communities obtaining water from wells along the Tuscarawas River should realize that those wells may produce high chloride water as pumping increases, because of infiltration from the river. The chloride content originates mostly as industrial waste. To keep infiltration a minimum, new wells should be widely spaced and located as far from the river as possible. Communities unable to increase supplies from underground sources have a choice of obtaining water directly from nearby streams if dry-season flow is sufficient, or by constructing surface or on-stream reservoirs, whichever is the more practical and economical.

Surface reservoirs can be constructed at sites along the streams in the area. Possible on-stream reservoir sites for consideration are shown on Map 7-1.

D. Recreation

Water recreational uses are not expected to require large areas of land in the future. Based on an Ohio State Outdoor Recreation Report prepared by ODNR water area for boating will be in surplus through the year 2000. The surplus is the result of the Muskingum River System and large existing multi-purpose reservoirs located in the eastern portion of the Basin.

The opportunities for development of fishing and swimming waters are based on present and projected demands from the State Outdoor Recreation Report. Combined fishing and swimming requirements will be 1100, 1590 and 2000 surface acres in 1980, 2000 and 2020 respectively (See Table 7-4).

Land for nonwater-oriented recreation activities is projected to be in surplus through the year 2000. However, projections indicate a need of 17,000 additional acres for these activities by the year 2020. Resources for these activities could be developed within existing state forests, parks, reclamation areas and on private lands. The developments would require little or no disturbance of the area's natural environment and cost would be minimal.

E. Fish and Wildlife

Opportunity for development of fish and wildlife habitat is better in the Basin than most other areas of the state. The rough and steeply rolling terrain in much of the Basin is not well suited for clean cultivated crops and about 40 percent of it is best suited for forest uses.

Development of ponds and improvement of springs to improve pasture use can make a significant contribution to wildlife habitat maintenance. This is also true for larger impoundments that are designed for flood control, water supply, recreation or other such uses.The impounded water creates habitat for fishes, frogs, turtles and other aquatic species. They attract such fish eating birds as kingfishers and green herons. In addition to

TABLE 7-4
Present Use and Projected Availability of Acreage for Recreation
Muskingum River Basin, Ohio

	1970		1980		2000		2020	
	Required Use	Available	Required Use	Available	Required Use	Available	Required Use	Available
Boating	32,930	61,130	42,700	62,200	60,100	67,800	77,900	67,900
Fishing	1,890	1,180	2,100	1,220	2,400	1,230	2,600	1,230
Swimming	330	210	400	180	610	190	820	190
Land Based Activities	50,880	198,180	83,300	196,200	148,100	200,600	218,100	201,100

Source: Stanley Report furnished by ODNR to Corps of Engineers, March 1969.

wood duck and mallard nesting habitat, these impoundments provide rest stops for other water birds that migrate through the area.

On-stream impoundments will have the adverse effect of changing the natural configuration of that portion of the stream bed located within the pool area. However, the structures should in part offset this effect by providing improved water quality down stream.

A conservation land treatment program will also greatly improve stream habitat. The present average annual gross erosion rate for the Basin is estimated at 4.65 tons per acre. Of this .12 tons per acre (2.6 percent) is delivered to the streams and rivers of the Basin. Sound conservation treatments and management applied to control runoff and erosion will reduce the annual gross erosion rate to three tons per acre or less and thereby improve water quality and stream fish habitat.

Planting of grass, shrubs, and trees adjacent to water resource improvements will improve the habitat for rabbits, quail, raccoons, songbirds, and several other species. Stripcropping and hedge row plantings will provide hundreds of miles of valuable edge for use by wildlife.

In addition to the fish and wildlife habitat available from other water resource development and conservation treatment measures there is a potential for extensive development exclusively for fish and wildife purposes. Wildlife habitat improvement practices, wetland improvement practices, wildlife pond development, and other such practices could provide over 125,000 acres of improved habitat. This could provide a significant increase in recreation opportunities for hunters and fishermen.

F. Forest Resource Development Potential

The 1971 Conservation Needs Inventory reveals opportunities for forest land developments through needed conservation practices. Establishment and reinforcement of timber stands are needed on approximately 405,900 acres. The opportunity for timber stand improvement exist on about 1,066,500 forest land acres. These figures indicate

a potential need for development of about 85.5 percent of the total forest land area within the Basin.

To meet land treatment provisions of Public Law 566 for lands above proposed structures, basic conservation plans are required. Technical assistance in planning and supervision of installation are available. Protection of water quality in proposed recreation and municipal and industrial water supply reservoirs would be significantly increased by establishment of tree cover on land adjacent to the water.

The Rural Environmental Conservation Program (Rural Environmental Assistance Program and Forestry Incentives Program) can provide cost sharing for most noncommercial forest practices. This program can be an effective force in encouraging and motivating forestry practices.

Chapter 8

ALTERNATIVE PLANS OF DEVELOPMENT AND PROGRAM IMPACTS

MUSKINGUM RIVER BASIN

Chapter 8. Alternative Plans of Development and Program Impacts

A. Plan Formulation

1. Planning Consideration
2. Coordination with Other Agencies
3. Program Alternatives
   a. General Description
   b. Program Summaries
   c. Program Alternatives
      Alternative I
      Alternative II
      Alternative III
      Alternative IV

B. Impacts

C. Recommended Short Range Plan

D. Long Range Comprehensive Plan

A. Plan Formulation

This section presents four alternative plans for development of water and related land resources in the Muskingum River Basin. It describes major element needs and ways of satisfying these needs under existing and anticipated agency authorities. Four alternatives are proposed for early action toward implementing the Basin plan. Each involves different levels of accomplishments and their costs. Some of the major impacts of the various alternatives are presented to indicate which resources may be benefited and which may be adversely affected.

1. Planning Considerations

Plan alternatives were developed after making an inventory of water and related land resources of the Basin. The inventory included a study of resource problems, needs, and opportunities for development. The kinds, amounts and conditions of these resources were studied in relation to the overall environmental quality of the Basin.

Throughout plan formulation, the intents were to develop a set or combination of measures which would: (1) allow for more efficient use of agricultural lands, (2) reduce sediment and erosion, (3) solve major flood problems, (4) provide additional storage for recreational water quality and domestic supply uses, and (5) improve the environment throughout the Basin.

Alternative plans were formulated by combining sets of development measures or activities that are mutually supportive, compatible and seem to be generally acceptable to various interests in the Basin. The plans offer solutions to various existing problems while providing for development, use, and management of the Basin resources to sustain future growth.

2. Coordination Among Agencies

The study was a joint effort of the U.S. Department of Agriculture and the U.S. Army Corps of Engineers. The Corps' responsibility for investigation was on the main stem of the Muskingum River, while the Department of Agriculture conducted investigations on upstream watersheds.

The study and the alternative plans of action developed by the USDA were a coordinated effort of the Economic Research Service, the Forest Service and the Soil Conservation Service. The Soil Conservation Service was designated the lead agency by the Department of Agriculture. It provided soil survey data, hydrologic and geologic studies, engineering design and costs, the land treatment program for open land, damage studies and environmental assessments.

The Economic Research Service assisted in providing existing and projected economic data on land use, employment, population, incomes and evaluation of the economic impacts of the alternative plans considered. The Forest Service provided necessary data concerning problems, needs, and potential for development on all forest land within the Basin. They assisted in determining and recommending conservation treatment needs and practices for forest land throughout the Basin.

The Ohio Department of Natural Resources provided information on needs and potential for development of fish and wildlife. This agency worked with the Soil Conservation Service biologist in compiling and formulating data for the plan. "The Water Inventory of the Muskingum River Basin," a report published by ODNR was used for basic data in plan formulation for water needs and potentials.

3. Program Alternatives

a. General Description

Four alternatives for early action programs are presented to provide flexibility in making decisions for implementing the comprehensive Basin plan. Each is based on the level of accomplishment that can be attained for different inputs during a ten year time frame. It is believed that a ten year period will give reasonably accurate estimates of potential developments under existing public authorities and policy considerations. All alternatives will require reorientation of program goals toward accomplishment of the Basin plan.

b. Program Summaries

Alternative I is a program designed to meet the most clearly defined present needs and can be accomplished under present authorities and funding. It could cause some policy conflicts with other agencies on both state and federal levels. This alternative is a "bench mark" program inasmuch as it is drawn within current frame works and provides the most detailed evaluation and estimates.

Alternative II is a full potential alternative. This alternative attempts to meet every identified need for water resource development. All needs are not met but failure to identify a physically feasible solution was the only limitation. Existing programs and policies were not considered a restraint.

Alternative III is a nonstructural program with minimum input under current program authority. It would accomplish goals through redirection of existing USDA program goals and activities.

Alternative IV represents the most comprehensive planning program considered. It consists of a stratification of the Basin according to resource potential and existing development trends. A combination of measures from the first three alternatives would be installed to provide maximum resource development and minimum disruption to natural development trend.

c. Discussion of Alternatives

Alternative I

Alternative I meets Basin needs of watershed protection, flood prevention, and water storage for other beneficial uses by installation of both land treatment measures and structural measures.

Watershed protection would be achieved through an accelerated land treatment program throughout the entire Muskingum River Basin. The program would protect the soil resource base, permit efficient and effective water management, improve environmental quality, insure continuation of adequate farm and timber production to meet

present and projected needs, and aid in the development of recreational opportunities. Land treatment measures are necessary to success of the overall development plan and would require that additional federal funds be made available to finance federal cost sharing for acceleration of existing land treatment programs.

The plan would require treatment of land not already adequately treated in the Basin. This presently includes 532,600 acres of cropland, 398,100 acres of pasture land, and 268,600 acres of forest land. Total estimated cost of land treatment measures is $30,337,900 which includes $6,473,200 for technical assistance (Table 8-1).

Flood prevention and development of water for other beneficial uses would be achieved by the installation of nine watershed projects. These watersheds are: Moxahala-Jonathan Creek, Wolf Creek, Big Run, South Fork, Log Pond Run, Beaverdam Creek, Conotton Creek, Buffalo Creek and Killbuck Creek (Map 8-1). Each of these watersheds has a feasible benefit-cost ratio (Table 8-4). Five of the watersheds are multi-purpose projects; Moxahala-Jonathan, Wolf Creek, South Fork, Buffalo Creek and Killbuck Creek. The nine watersheds include 44 floodwater retarding reservoirs (eleven being multi-purpose) and 43 miles of channel work (Table 8-2). All reservoirs would be built to serve flood prevention purposes. Projects would be initiated and carried out by local sponsors with federal technical and financial assistance. Total installation cost of all structural measures is estimated at $26,770,300 (Table 8-3) with an average annual cost of $1,631,300. The total net benefits to be realized from such measures is $2,807,500 annually. Net benefits are the total annual benefits, excluding land treatment benefits, minus the average annual cost.

Alternative II

Alternative II program includes installation of single purpose projects for flood control and other beneficial uses (Map 8-2). Eight watersheds would be developed for flood prevention purposes only (Table 8-6). These eight watersheds are: Moxahala-Jonathan, Big Run, South Fork, Log Pond, Beaverdam Creek, Conotton Creek, Buffalo Creek and Killbuck Creek. Total average annual cost for

TABLE 8-1
Summary of Land Treatment Costs
Alternative I
Muskingum River Basin, Ohio

Sheet 1 of 2

Conservation Treatment Practices	Present Needs	Acres to be Treated During 10-Year Period	Remaining Needs	Federal Costs	Other Funds	Total Cost
	---------------	Acres	---------------			
Cropland						
Annual Cover	46,800	31,200	15,600	-	$ 37,400	$ 37,400
Sod in Rotation	206,500	137,500	69,000	-	-	-
Strip, Terracing, and Diversions	435,200	289,800	145,400	-	2,898,000	2,898,000
Contouring Only	79,700	53,100	26,600	-	13,300	13,300
Permanent Cover	31,500	21,000	10,500	-	73,500	73,500
Subtotal	799,700	532,600	267,100	-	$3,022,200	$3,022,200
Pasture						
Protection Only	34,900	23,200	11,700	-	$ 812,000	$ 812,000
Improvement Only	305,800	203,700	102,100	-	7,129,500	7,129,500
Brush Control	117,000	77,900	39,100	-	2,726,500	2,726,500
Reestablishment of Vegetative Cover	46,500	31,000	15,500	-	1,550,000	1,550,000
Reestablishment of Brush Control	93,600	62,300	31,300	-	3,115,000	3,115,000
No Treatment Feasible	16,400	-	16,400	-	-	-
Subtotal	614,200	398,100	216,100	-	$15,333,000	$15,333,000

Table 8-1 cont'd

Conservation Treatment Practices	Present Needs	Acres to be Treated During 10-Year Period	Remaining Needs	Federal Costs	Other Funds	Total Cost
	---------------Acres	---------------				
Forest Land						
Tree Planting	366,000	60,000	306,000	-	$2,400,000	$2,400,000
Timber Stand Imp.	1,066,500	50,000	1,016,500	-	1,782,000	1,782,000
Grazing Control	300,000	30,000	270,000	-	750,000	750,000
Harvest Cutting	154,000	103,000	51,000	-	513,500	513,500
Erosion Control	32,000	25,600	6,400	-	64,000	64,000
Subtotal	1,918,500	268,600	1,649,900	-	$5,509,500	$5,509,500
Technical Assis.						
Soil Conservation Service	-	-	-	3,130,200	-	$3,130,200
Forest Service	-	-	-	3,343,000	-	3,343,000
Subtotal	-	-	-	6,473,200	-	$6,473,200
Total Cost for Land Treatment Program	-	-	-	6,473,200	$23,864,700	$30,337,900

Price Base 1972

Table 8-2
Structural Data for Feasible Watersheds
Alternative I
Muskingum River Basin, Ohio

Watershed	Drainage Area (Sq. Miles)	Structures Proposed (Number)	Multi-Purpose Structures (Number)	Length of Channel Work (Miles)
Moxahala-Jonathan	301.0	10	3	-
Wolf Creek	231.0	10	3	-
Big Run	31.9	1	-	4.9
South Fork	287.0	9	1	24.4
Log Pond	9.6	1	1	1.7
Beaverdam Cr.	10.4	2	-	-
Conotton Cr.	56.8	-	-	3.3
Buffalo Cr.	50.2	3	1	8.7
Killbuck Cr.	89.2	8	2	-
TOTAL	1067.1	44	11	43.0

Table 8-3
Distribution of Structural Cost
Alternative I
Muskingum River Basin, Ohio

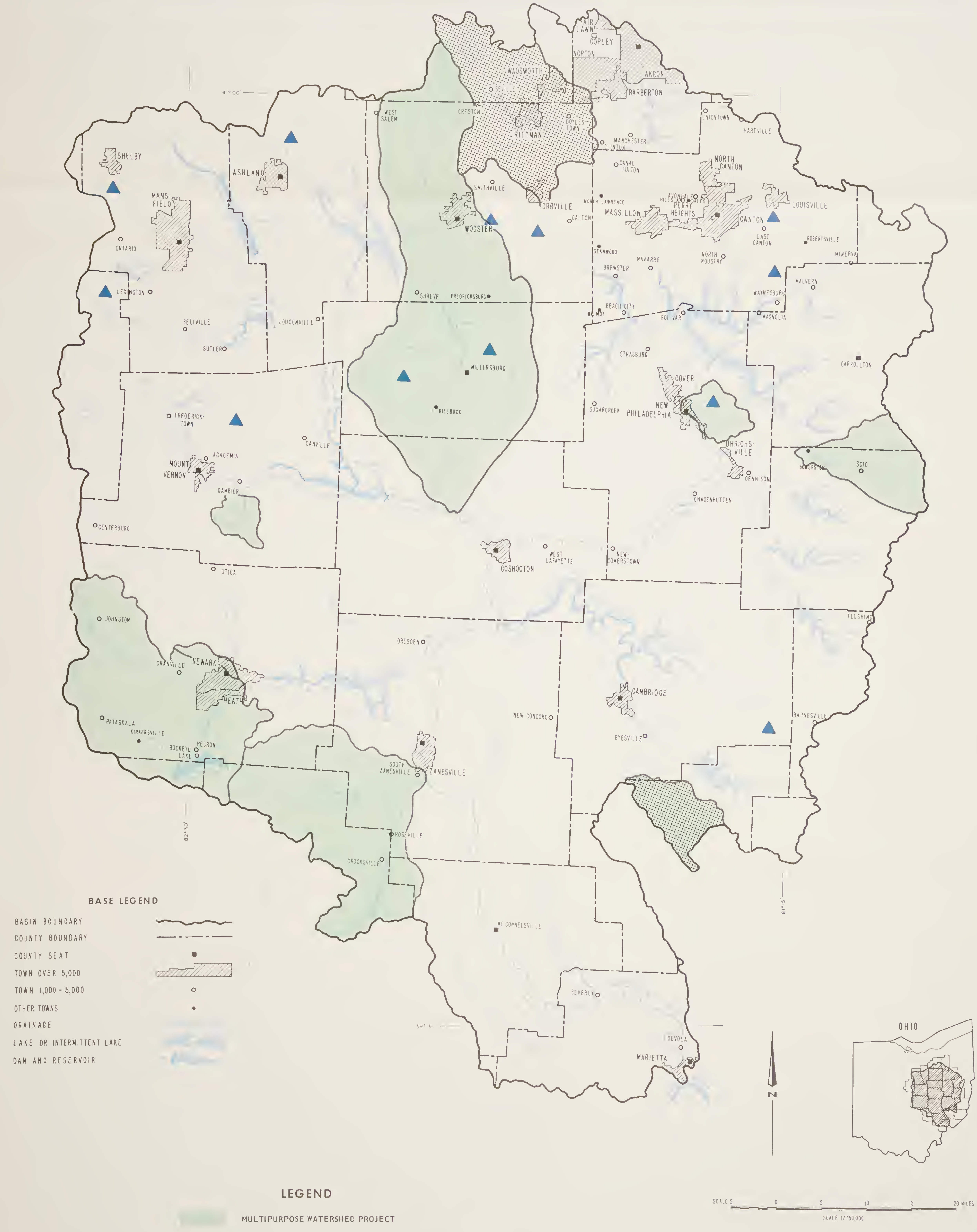
Watershed	Construction	Installation Services and Project Administration	Land Rights	Total Installation
Moxahala-Jonathan	$ 3,584,000	$ 719,000	$1,118,000	$ 5,421,000
Wolf Creek	2,529,000	506,000	1,187,000	4,222,000
Big Run	377,300	47,300	77,000	501,600
South Fork	3,269,400	1,044,400	1,333,000	5,646,800
Log Pond	531,700	130,100	464,200	1,126,000
Beaverdam Cr.	645,500	185,300	209,900	1,040,700
Conotton Cr.	267,000	37,300	19,100	323,400
Buffalo Cr.	905,100	312,700	190,000	1,407,800
Killbuck Cr.	4,221,000	1,094,000	1,766,000	7,081,000
TOTAL	$16,330,000	$4,076,100	$6,364,200	$26,770,300

Price Base 1972

Table 8-4
Comparison of Benefits and Cost for Structural Measures
Alternative I
Muskingum River Basin, Ohio

Watershed	Flood Prevention Benefits		Recreation	Municipal & Industrial Water Supply	Redevelopment	Secondary	Total Annual Benefits	Average Annual Cost 1/	Benefit Cost Ratio
	Damage Reduction	More Intensive Use							
Moxahala-Jonathan	$ 196,000	-	$204,300	$ 12,000	$ 94,000	$ 19,400	$ 525,700	$ 341,200	1.54:1.0
Wolf Creek	45,500	$17,300	333,900	81,000	69,900	6,000	553,600	241,000	2.30:1.0
Big Run	33,200	2,700	-	-	-	3,500	39,400	30,300	1.30:1.0
South Fork	565,500	-	82,500	-	-	55,400	703,400	351,000	2.00:1.0
Log Pond	108,400	-	-	-	-	10,800	119,200	66,200	1.80:1.0
Beaverdam Cr.	44,200	-	-	-	17,800	4,400	66,400	62,000	1.07:1.0
Conotton Cr.	67,400	-	-	-	-	6,700	74,100	19,600	3.78:1.0
Buffalo Cr.	41,300	12,300	-	3,300	25,000	6,300	88,200	84,000	1.05:1.0
Killbuck Cr.	361,600	-	-	189,600	-	86,300	637,500	436,000	1.46:1.0
TOTAL	$1,463,100	$32,300	$620,700	$285,900	$206,700	$198,800	$2,807,500	$1,631,300	1.72:1.0

1/ Interest rate 5 7/8 percent, 100-year evaluation period.



BASE LEGEND

- BASIN BOUNDARY
- COUNTY BOUNDARY
- COUNTY SEAT
- TOWN OVER 5,000
- TOWN 1,000 - 5,000
- OTHER TOWNS
- DRAINAGE
- LAKE OR INTERMITTENT LAKE
- DAM AND RESERVOIR

LEGEND

- MULTIPURPOSE WATERSHED PROJECT
- OPERATIONAL P.L. 566 PROJECT
- SINGLE PURPOSE WATER SUPPLY STRUCTURE

ALTERNATIVE II
MUSKINGUM RIVER BASIN
OHIO

MAP 8-2

SOURCE: FAMILY OF MAPS SCS DRAWING NO. 5,R-12,793 (1-10-74) AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION.

USDA-SCS-LINCOLN, NEBR. 1974

9-12-74
5,P-34,380

these measures is estimated at $1,182,500. Benefits to be realized from damage reduction, more intensive land use, redevelopment, and secondary effects is an estimated $1,732,900 annually (Table 8-8).

Another twelve reservoirs would be installed for municipal and industrial water supply. These reservoirs would provide or aid in providing the projected needs for municipal water for the following towns: Ashland, Barnesville, Killbuck, Millersburg, Mt. Vernon, Ontario, Shelby, Louisville, Hartville, Rosewell, Orrville, and Wooster. Total average annual cost for the installation of these measures is estimated at $648,500 (Table 8-9).

An accelerated land treatment program of the same magnitude as in Alernative I would also be initiated under this Alternative (Table 8-5).

Alternative III

Alternative III includes a subsidized land treatment program with federal funding in excess of going USDA program costs. Under the proposal, an accelerated land treatment program usually planned for a 15-year installation period would be accomplished in 10 years. The estimated cost for carrying out such a program on approximately 1,872,500 acres would be $49.3 million (Table 8-10).

Land treatment measures would be applied on about 800,000 acres of cropland. Such measures would include grasses and legumes in rotation, contouring, strip cropping, terraces, diversions, and permanent cover. The estimated cost is $4.5 million.

Pastureland treatment is proposed for nearly 600,000 acres of agricultural land at a cost of approximately $23 million. Measures include lime and fertilizer application, weed and brush control, and protection and reestablishment of vegetative cover.

A combination of forestry measures including timber stand improvement, establishment and reinforcement of timber stands, insect and disease control, and protection

Table 8-5
Summary of Land Treatment Costs
Alternative II 1/
Muskingum River Basin, Ohio

Conservation Treatment Practices	Present Needs	Acres to be Treated During 10-year Period	Remaining Needs	Federal Costs	Other Funds	Total Cost
	---Acres---					
Cropland						
Annual Cover	46,800	31,200	15,600	-	$ 37,400	$ 37,400
Sod in Rotation	206,500	137,500	69,000	-	-	-
Strip, Terracing, and Diversions	435,200	289,800	145,400	-	2,898,000	2,898,000
Contouring Only	79,700	53,100	26,600	-	13,300	13,300
Permanent Cover	31,500	21,000	10,500	-	73,500	73,500
Subtotal	799,700	532,600	267,100	-	$3,022,200	$3,022,200
Pasture						
Protection Only	34,900	23,200	11,700	-	$ 812,000	$ 812,000
Improvement Only	305,800	203,700	102,100	-	7,129,500	7,129,500
Brush Control	117,000	77,900	39,100	-	2,726,500	2,726,500
Reestablishment of Vegetative Cover	46,500	31,000	15,500	-	1,550,000	1,550,000
Reestablishment of Brush Control	93,600	62,300	31,300	-	3,115,000	3,115,000
No Treatment Feasible	16,400	-	16,400	-	-	-
Subtotal	614,200	398,100	216,100	-	$15,333,000	$15,333,000

Table 8-5 cont'd

Conservation Treatment Practices	Present Needs	Acres to be Treated During 10-year Period	Remaining Needs	Federal Costs	Other Funds	Total Cost
	---------------	Acres	---------------			
Forest Land						
Tree Planting	366,000	60,000	306,000	-	$2,400,000	$2,400,000
Timber Stand Imp.	1,066,500	50,000	1,016,500	-	1,782,000	1,782,000
Grazing Control	300,000	30,000	270,000	-	750,000	750,000
Harvest Cutting	154,000	103,000	51,000	-	513,500	513,500
Erosion Control	32,000	25,600	6,400	-	64,000	64,000
Subtotal	1,918,500	268,600	1,649,900	-	$5,509,500	$5,509,500
Technical Assistance						
Soil Conservation Service	-	-	-	3,130,200	-	$3,130,200
Forest Service	-	-	-	3,343,000	-	3,343,000
Subtotal	-	-	-	6,473,200	-	$6,473,200
Total Cost for Land Treatment Program	-	-	-	6,473,200	$23,864,700	$30,337,900

Price Base 1972

1/ Same as Alternative I

Table 8-6
Physical Data for Feasible Watersheds
Alternative II
Muskingum River Basin, Ohio

Watershed	Drainage Area (Sq. Miles)	Structures Proposed (Number)	Length of Channel Work (Miles)
Moxahala-Jonathan	301.0	10	-
Big Run	31.9	1	4.9
South Fork	287.0	9	24.4
Log Pond	9.6	1	1.7
Beaverdam Creek	10.4	2	-
Conotton Creek	56.8	-	3.3
Buffalo Creek	50.2	3	3.7
Killbuck Creek	89.2	8	-
Total	836.1	34	38.0

Table 8-7
Distribution of Structural Costs
Alternative II
Flood Prevention Only
Muskingum River Basin, Ohio

Watershed	Construction	Installation Service and Project Administration	Land Rights	Total Installation
Moxahala-Jonathan	$ 2,902,000	$ 581,000	$ 967,000	$ 4,450,000
Big Run	377,300	47,300	77,000	501,600
South Fork	3,269,400	1,044,400	1,333,000	5,646,800
Log Pond	531,700	130,100	464,200	1,126,000
Beaverdam Cr.	645,500	185,300	209,900	1,040,700
Conotton Cr.	267,000	37,300	19,100	323,400
Buffalo Cr.	343,200	97,100	166,500	606,800
Killbuck Cr.	3,515,000	931,000	1,394,000	5,840,000
Total	$11,851,100	$3,053,500	$4,630,700	$19,535,300

Price Base 1972

Table 8-8
Comparison of Benefits and Cost for Structural Measures
Alternative II
Flood Prevention Only
Muskingum River Basin, Ohio

Watershed	Damage Reduction	More Intensive Use	Redevelopment	Secondary	Annual Benefits	Average Annual Cost 1/	Benefit Cost Ratio
Moxahala-Jonathan	$ 196,000	-	$ 80,200	$ 19,400	$ 295,600	$ 269,900	1.09:1.0
Big Run	33,200	$ 2,700	-	3,500	39,400	30,300	1.30:1.0
South Fork	565,500	-	-	55,400	620,900	351,000	1.77:1.0
Log Pond	108,400	-	-	10,800	119,200	66,200	1.80:1.0
Beaverdam Cr.	44,200	-	17,800	4,400	66,400	62,000	1.07:1.0
Conotton Cr.	67,400	-	-	6,700	74,100	19,600	3.78:1.0
Buffalo Cr.	41,300	12,300	9,500	6,300	69,400	36,000	1.93:1.0
Killbuck Cr.	361,600	-	-	86,300	447,900	347,500	1.29:1.0
TOTAL	$1,417,600	$15,000	$107,500	$192,800	$1,732,900	$1,182,500	1.47:1.0

1/ Interest rate 5 7/8 percent, 100-year evaluation period.

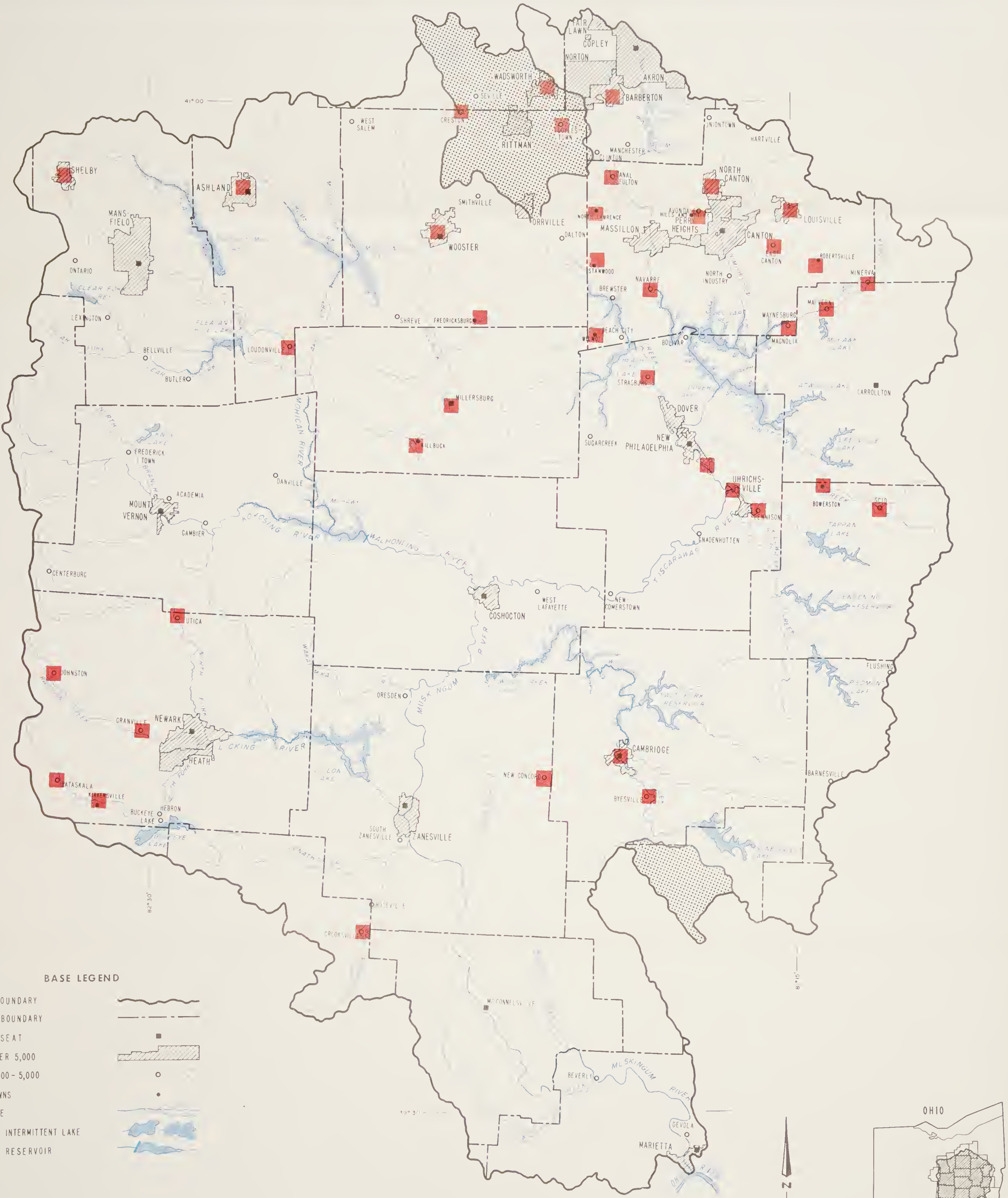
Table 8-9
Data for Municipal Water Supply Development
Alternative II 2/
Muskingum River Basin, Ohio

Watershed	Community	Projected Need (MGD)	Site No:	With Project (MGD)	Average Annual 1/ Installation Cost
Mohican	Ashland	5.03	4B1-2(5+)	5.43	$ 79,700
Leatherwood	Barnesville	0.87	4C-7.3(18A)	0.87	25,800
Black Creek	Killbuck	0.31	4B-3.4(5)	0.52	18,000
Killbuck	Millersburg	0.66	4B-3.5(26)	1.38	34,900
Kokosing	Mt. Vernon	4.28	4B-4(12)	4.31	55,600
Mohican	Ontario	1.26	4B1-3(1)	1.59	27,000
Mochian	Shelby	5.35	4B1-4(1)	4.26	110,700
Nimishillen	Louisville	0.78	4A-12.2(1)	1.22	36,700
Sandy	Hartville	0.24	4A-12.2(3)	0.98	19,000
Beaverdam	Rosewell	0.05	4A-8(1)	0.32	12,600
Sugar Creek	Orrville	3.54	4A-10(4A)	2.34	39,000
Killbuck	Wooster	10.25	4B-3.5(6 & 8)	10.72	189,500

1/ Interest rate 5 7/8 percent.

2/ Single purpose water supply reservoir.

U. S. DEPARTMENT OF AGRICULTURE



BASE LEGEND

BASIN BOUNDARY
COUNTY BOUNDARY
COUNTY SEAT
TOWN OVER 5,000
TOWN 1,000 - 5,000
OTHER TOWNS
DRAINAGE
LAKE OR INTERMITTENT LAKE
DAM AND RESERVOIR

SCALE 5 0 5 10 15 20 MILES
SCALE 1/750,000

LEGEND

OPERATIONAL P.L. 566 PROJECT

PROPOSED FLOOD HAZARD STUDY

ALTERNATIVE III
MUSKINGUM RIVER BASIN
OHIO

MAP 8-3

SOURCE: FAMILY OF MAPS SLS DRAWING NO. 5,R-32,733 (1-30-74) AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION.

USDA-SCS-LINCOLN, NEBR. 1974

9-12-74
5,P-34,381

from grazing would be applied on about 395,000 acres at an estimated cost of $8.2 million.

Technical assistance for the above measures will cost an estimated $10.1 million.

Reclamation of stripmine land is planned for approximately 80,000 acres at a cost of about $3.4 million. Of the 80,000 acres, 24,000 acres will be put in grass, and 56,000 acres will be under reforestation. At the present time, there is no USDA cost-sharing program covering stripmine reclamation measures.

Presently, about 111,600 acres of agricultural land is inundated by the two year flood event. With the subsidized land treatment measures applied, it is estimated that the number of acres flooded will be reduced six percent. This leaves approximately 104,900 acres which the two year event will inundate. Alternative III proposes purchase of the remaining agricultural land flooded by the two year event. The use of the purchased land would be converted to permanent wildlife cover and recreational uses. The average value of agricultural land in the Basin is $450 per acre making the estimated total cost for flood plain purchase $47.2 million.

Land use and zoning laws will also need to be adopted to cope with future population and economic expansion. Such laws should provide for the orderly growth of housing and commercial developments in the Basin. Responsibility for this lies with county and municipal governments. Assistance can be provided by state and regional planning commissions. It is desirable that zoning laws complement future development plans of state and federal agencies. Zoning boards should include representatives of county and municipal governments, soil and water conservation districts, and other organizations interested in comprehensive resource development programs of the Basin.

Where development is currently located in the flood plain, flood insurance is available through the National Flood Insurance Program, authorized by the Housing and Urban Development Act of 1968 (Public Law 90-448). The program is administered by the Federal Insurance Administration of the U.S. Department of Housing and Urban

Development, in cooperation with private insurance companies. The intent of the program is to: (1) provide insurance on structures and contents against flood damages with insurance rates based on the hazard and frequency of flooding; (2) regulate development in flood-prone areas; (3) implement local land use and management in the flood plain area.

An accurate determination of the flood prone area is needed before local land use and zoning regulations can be effectively implemented. Flood hazard studies are needed for 39 communities in the Basin where flooding is a problem and future development is expected (Map 8-3). Basically, a flood hazard study involves the evaluation of various frequency storms so as to determine the extent of flooding that can occur along a given stream. From this information, zoning boards can be effectively determined: (1) areas for industrial growth; (2) location of highways; (3) areas for home sites, (4) future use of bottomland; (5) location of schools and municipal facilities; (6) location of recreation sites; (7) preservation of good agricultural land for agricultural use; and (8) preservation of historical and natural beauty spots. The estimated cost for these studies is $9,000,000.

The total estimated cost for Alternative III is in excess of $105 million.

Alternative IV

Alternative IV program would divide the Basin into three generalized areas according to resource potential and existing development trends (Map 8-4). Primary development needs of Area I are related mostly to agriculture, but does include some development of multi-purpose projects. Area II, the northern portion of the Basin and most populated, gives rise to land and water development for urban uses. Area III, having numerous recreational water developments, would be evaluated on the basis for recreational and environmental improvement needs.

This alternative includes the same accelerated land treatment program and 39 flood hazard studies set forth in Alternative III (Table 8-11). The structural aspects includes 12 water supply reservoirs (Table 8-15) and

Table 8-10
Summary of Land Treatment Costs
Alternative III
Muskingum River Basin, Ohio

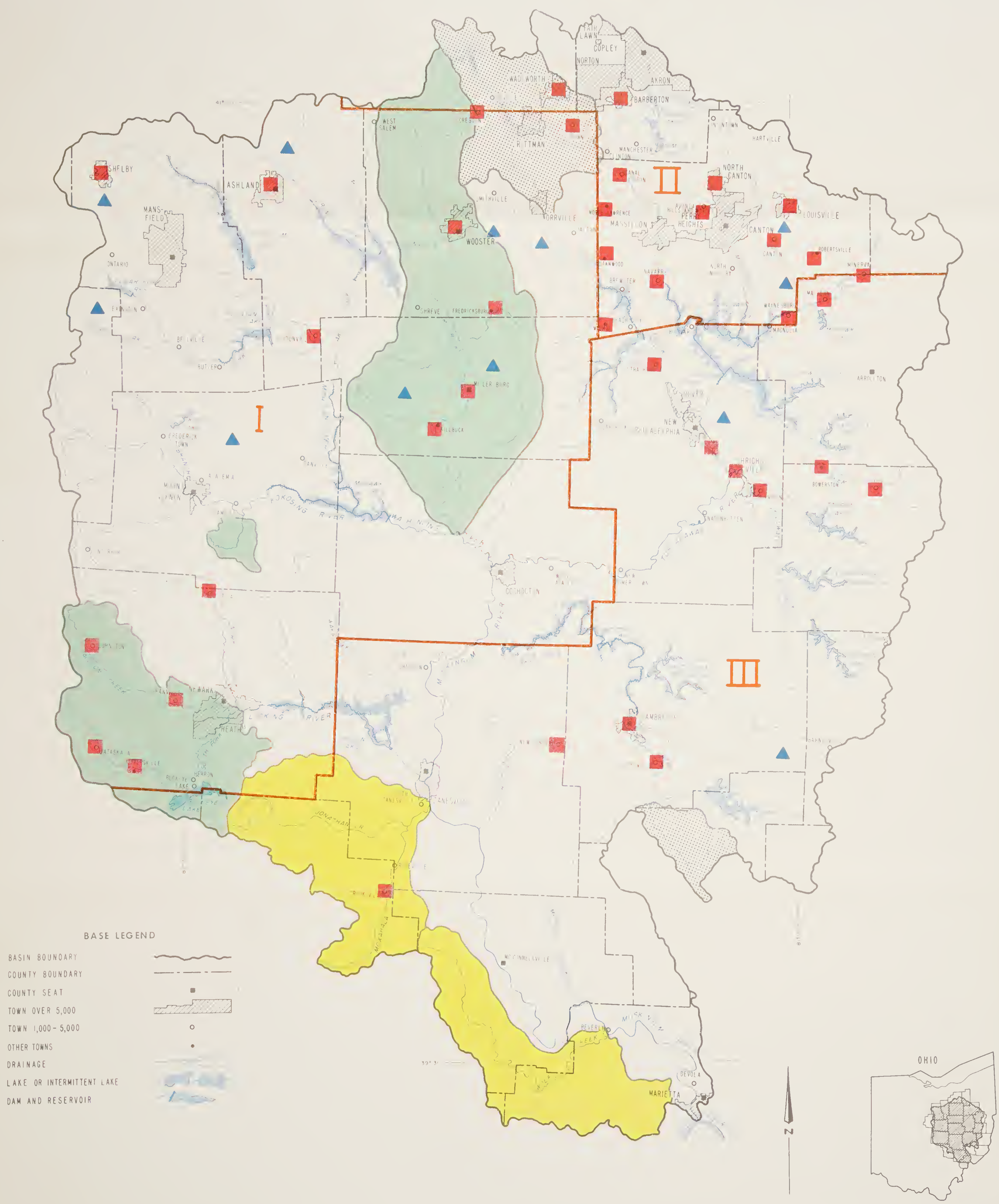
Subsidized Conservation Treatment Practices	Present Needs	Acres to be Treated During 10-yr. Period	Remaining Need	Federal Costs Subsidized Program	Federal Costs Going Programs	Other Funds	Total Cost
	------------Acres------------						
Cropland							
Annual Cover	46,800	46,800	-	$ 9,400	-	$ 46,800	$ 56,200
Sod in Rotation	206,500	206,500	-	-	-	-	-
Strip, Terracing, and Diversions	435,200	435,200	-	727,000	-	3,625,000	4,352,000
Contouring Only	79,700	79,700	-	3,300	-	16,600	19,900
Permanent Cover	31,500	31,500	-	18,400	-	91,800	110,200
Subtotal	799,700	799,700	-	$ 758,100	-	$ 3,780,200	$ 4,538,300
Pasture							
Protection Only	34,900	34,900	-	$ 204,700	-	$ 1,016,800	$ 1,221,500
Improvement Only	305,800	305,800	-	1,786,700	-	8,916,300	10,703,000
Brush Control	117,000	117,000	-	684,200	-	3,410,800	4,095,000
Reestablishment of Vegetative Cover	46,500	46,500	-	387,500	-	1,937,500	2,325,000
Reestablishment of Brush Control	93,600	93,600	-	782,500	-	3,897,500	4,680,000
No Treatment Feasible	16,400	-	16,400	-	-	-	-
Subtotal	614,200	597,800	16,400	$3,845,600	-	$19,178,900	$23,024,500

Table 8-10 cont'd

Sheet 2 of 2

Subsidized Conservation Treatment Practices	Present Needs	Acres to be Treated During 10-yr. Period	Remaining Need	Federal Costs: Subsidized Program	Federal Costs: Going Program	Other Funds	Total Cost
	----------Acres	----------	----------				
Forest Land							
Tree Planting	366,000	90,000	276,000	$ 1,200,000	-	$ 2,400,000	$ 3,600,000
Timber Stand Imp.	1,066,500	74,000	992,500	882,000	-	1,782,000	2,664,000
Grazing Control	300,000	45,000	255,000	374,000	-	750,000	1,124,000
Harvest Cutting	154,000	154,000	-	256,500	-	513,500	770,000
Erosion Control	32,000	32,000	-	16,000	-	64,000	80,000
Stripmine Land	80,000	80,000	-	-	-	3,440,000	3,440,000
Subtotal	1,998,500	475,000	1,523,500	$ 2,728,500	-	$ 8,949,599	$11,678,000
Flood Plain Purchase	104,000	-	-	-	-	$47,200,000	$47,200,000
Technical Assistance							
Soil Conservation Service	-	-	-	$ 1,569,800	$3,130,200	-	$ 4,700,000
Forest Service	-	-	-	2,047,000	3,343,000	-	5,390,000
Subtotal	-	-	-	$ 3,616,800	$6,473,200	-	$10,090,000
Total Cost of Program	-	-	-	$10,949,000	$6,473,200	$79,108,600	$96,530,800

Price Base 1972



LEGEND

MULTIPURPOSE WATERSHED PROJECT

OPERATIONAL P.L. 566 PROJECT

RECREATIONAL WATERSHED PROJECT

SINGLE PURPOSE WATER SUPPLY STRUCTURE

PROPOSED FLOOD HAZARD STUDY

DEVELOPMENT AREA

ALTERNATIVE IV
MUSKINGUM RIVER BASIN
OHIO

MAP 8-4

SOURCE: FAMILY OF MAPS SCS DRAWING NO. 5,R-33,783 (1968-74) AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION

9-12-74
5,P-34,382

USDA SCS-LINCOLN NEBR 1974

three watershed projects formulated to provide flood protection to the agricultural areas. The recreation potential would be developed in two watersheds. It is further recommended that two watershed projects already authorized for installation under PL-566 be carried to completion. The total cost of this alternative is estimated over $81.7 million.

Area I

The Chippewa Creek Watershed Project is presently under construction. When completed it will provide an estimated 53 percent reduction in floodwater damages. In monetary terms, the project will eliminate about $92,000 annual damages to crops and pasture. It will allow for an estimated $38,000 annual increase in crop production from changed land use. Fish and wildlife and recreational benefits will be realized from the installation of this project.

Watershed projects were evaluated on the basis of providing less than the 100-year level of protection because the area is mostly agricultural. Three watershed projects are recommended in this Alternative for the area. The projects are: Killbuck Creek, Big Run, and South Fork Licking River (Tables 8-12 and 8-13). These projects would reduce flooding and allow for more intensive land use of flood plain resulting in increased production and quality. The annual benefits to be realized from this alternative level are estimated at $1,108,200. The estimated annual cost of the three projects is $728,800 (Table 8-14).

This alternative includes installation of eight reservoirs to service communities with municipal water supplies. These communities are: Killbuck, Millersburg, Mt. Vernon, Ontario, Shelby, Orrville, Wooster, and Ashland. These reservoirs could be installed at an overall estimated annual cost of $554,400.

To reduce future floodwater damages in the communities of Area I, fourteen flood hazard studies are included in this alternative. The communities needing to be studied are: Shelby, Ashland, Wooster, Creston, Doylestown, Loudonville, Millersburg, Killbuck, Utica, Granville, Johnstown, Pataskala, Kirkersville, and Fredericksburg. These

studies would aid in regulating development in flood plain areas and provide the Housing and Urban Development Agency with necessary information for determining rates for flood insurance.

Area II

This area is expected to have predominatetly urban oriented land and water development needs. Flood hazard studies are recommended for fourteen communities in the area, namely: Wadsworth, Barberton, Canal Fulton, North Lawrence, Standwood, Navarre, Wilmot, Waynesburg, Robertsville, Minerva, East Canton, Hills and Dale, North Canton, and Louisville.

Two municipal water storage reservoirs are proposed in this area which could meet the projected needs for Louisville and Hartville. These reservoirs could be installed at annual costs of $36,700 for the project at Louisville and $19,000 for the Hartville project (Table 8-15).

Area III

Land and water development needs of Area III are oriented toward recreational and environmental improvement. This alternative includes recreational development to two of the watersheds discussed in Alternative I. The Moxahala-Jonathan Watershed has $205,000 average annual recreation benefits and Wolf Creek $334,000. According to recent recreation studies the demand for recreation in the Basin will not exceed supply until about the year 2000.

Water and land resource development will probably play a large role in attracting new job creating industries to this area. The topography is highly suitable for recreational development where amply facilties already exist.

Eleven flood hazard studies are recommended for this area. The communities suggested are: Malvern, Strasburg, New Philadelphia, Uhrichsville, Dennison, Bowerstown, Scio, Cambridge, Byesville, New Concord, and Crooksville.

Two municipal water storage reservoirs are included in this area which could meet projected needs for Barnesville

Table 8-11
Summary of Land Treatment Costs
Alternative IV
Muskingum River Basin, Ohio

Subsidized Conservation Treatment Practices	Present Needs	Acres to be Treated During 10-yr. Period	Remaining Needs	Federal Costs Subsidized Program	Federal Costs Going Programs	Other Funds	Total Cost
	-----------Acres-------------						
Cropland							
Annual Cover	46,800	46,800	-	$ 9,400	-	$ 46,800	$ 56,200
Sod in Totation	206,500	206,500	-	-	-	-	-
Strip, Terracing, and Diversions	435,200	435,200	-	727,000	-	3,625,000	4,352,000
Contouring Only	79,700	79,700	-	3,300	-	16,600	19,900
Permanent Cover	31,500	31,500	-	18,400	-	91,800	110,200
Subtotal	799,700	799,700	-	$ 758,100	-	$ 3,780,200	$ 4,538,300
Pasture							
Protection Only	34,900	34,900	-	204,700	-	$ 1,016,800	$ 1,221,500
Improvement Only	305,800	305,800	-	$1,786,700	-	8,916,300	10,703,000
Brush Control	117,000	117,000	-	684,200	-	3,410,800	4,095,000
Reestablishment of Vegetative Cover	46,500	46,500	-	387,500	-	1,937,500	2,325,000
Reestablishment of Brush Control	93,600	93,600	-	782,500	-	3,897,500	4,680,000
No Treatment Feasible	16,400	-	16,400	-	-	-	-
Subtotal	614,200	597,800	16,400	$3,845,600	-	$19,178,900	$23,024,500

Table 8-11 cont'd

Subsidized Conservation Treatment Practices	Present Needs	Acres to be Treated During 10-yr. Period	Remaining Needs	Federal Costs Subsidized Program	Federal Costs Going Programs	Other Funds	Total Cost
	--------------Acres	-----------					
Forest Land							
Tree Planting	366,000	90,000	276,000	$ 1,200,000	-	$ 2,400,000	$ 3,600,000
Timber Stand Imp.	1,066,500	74,000	992,500	882,000	-	1,782,000	2,664,000
Grazing Control	300,000	45,000	255,000	374,000	-	750,000	1,124,000
Harvest Cutting	154,000	154,000	-	256,500	-	513,500	770,000
Erosion Control	32,000	32,000	-	16,000	-	64,000	80,000
Stripmine Land	80,000	80,000	-	-	-	3,440,000	3,440,000
Subtotal	1,998,500	475,000	1,523,500	$ 2,728,500	-	$ 8,949,500	$11,678,000
Technical Assistance							
Soil Conservation Service	-	-	-	$ 1,569,800	$3,130,200	-	$ 4,700,000
Forest Service	-	-	-	2,047,000	3,343,000	-	5,390,000
Subtotal	-	-	-	$ 3,616,800	$6,473,200	-	$10,090,000
Total Cost of Program	-	-	-	$10,949,000	$6,473,200	$31,908,600	$49,330,800

Price Base 1972

Table 8-12
Physical Data for Feasible Watersheds
Alternative IV
Muskingum River Basin, Ohio

Watershed	Drainage Area (Sq. Miles)	Structures Proposed (Number)	Length of Channel Work (Miles)
Killbuck Creek	89.2	8	-
Big Run	31.9	1	4.9
South Fork	287.2	9	24.4
Total	408.3	18	29.3

Table 8-13
Distribution of Structural Costs
Alternative IV
Muskingum River Basin, Ohio

Watershed	Construction	Installation Services and Project Administration	Land Rights	Total Installation
Killbuck Creek	$3,515,000	$ 931,000	$1,394,000	$ 5,840,000
Big Run	377,300	47,300	77,000	501,600
South Fork and Raccoon Creek	3,269,400	1,044,400	1,333,000	5,646,800
Total	$7,161,700	$2,022,700	$2,804,000	$11,988,400

Price Base 1972

Table 8-14
Comparison of Benefits and Cost for Structural Measures
Alternative IV
Muskingum River Basin, Ohio

Watershed	Damage Reduction	More Intensive Use	Secondary	Annual Benefits	Average Annual Cost 1/	Benefit Cost Ratio
Killbuck Creek	$361,600	-	$ 86,300	$ 447,900	$347,500	1.29:1.0
Big Run	33,200	$2,700	3,500	39,400	30,300	1.30:1.0
South Fork and Raccoon Creek	565,500	-	55,400	620,900	351,000	1.77:1.0
Total	$960,300	$2,700	$145,200	$1,108,200	$728,800	1,52:1.0

1/ Interest rate 5 7/8 percent.

Table 8-15
Data for Municipal Water Supply Development
Alternative IV
Muskingum River Basin, Ohio

Watershed	Town	Projected Need (MGD)	Site No:	With Project (MGD)	Average Annual 1/ Installation Cost
Mohican	Ashland	5.03	4B1-2(5+)	5.43	$ 79,700
Leatherwood	Barnesville	0.87	4C-7.3(18A)	0.87	25,800
Black Creek	Killbuck	0.31	4B-3.4(5)	0.52	18,000
Killbuck	Millersburg	0.66	4B-3.5(26)	1.38	34,900
Kokosing	Mt. Vernon	4.28	4B-4(12)	4.31	55,600
Mohican	Ontario	1.26	4B1-3(1)	1.59	27,000
Mohican	Shelby	5.35	4B1-4(1)	4.26	110,700
Nimishillen	Louisville	0.78	4A-12.2(1)	1.22	36,700
Sandy	Hartville	0.24	4A-12.2(3)	0.98	19,000
Beaverdam	Rosewell	0.05	4A-8(1)	0.32	12,600
Sugar Creek	Orrville	3.54	4A-10(4A)	2.34	39,000
Killbuck	Wooster	10.25	4B-3.5(6 & 8)	10.72	189,500

1/ Interest rate 5 7/8 percent.

U. S. DEPARTMENT OF AGRICULTURE

SHORT RANGE PLAN
MUSKINGUM RIVER BASIN
OHIO

MAP 8-5

SOURCE: FAMILY OF MAPS SCS DRAWING NO. 5,R-32,783 (1-30-74) AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION.

USDA-SCS-LINCOLN, NEBR. 1974

9-12-74
5,P-34,383

and Rosewell. These reservoirs could be installed at annual costs of $25,800 and $12,600, respectively (Table 8-15).

The Buffalo Creek Watershed is approved for construction. When completed, this measure will reduce annual floodwater damage, enhance agricultural lands, and provide storage for municipal and industrial water supply. The annual cost of this project is estimated at $84,000 (Table 8-22).

B. Impacts

Tables 8-16, 8-17, and 8-18 provide estimates of production level and development level situations useful in analyzing various alternatives. These tables show comparisions of selected variables between normal1/ and maximum production levels for both "with and without development" assumptions. Without development means projections were made under existing levels of drainage and flood protection. With development means that the level of drainage and flood protection shown in the Tables were assumed to be installed.

Tables 8-16 reflects a normal demand increase to 1980 with no development compared to the same level with development. The reduction in total production cost when substituting development for less efficient resources is $173,000. It would be necessary to increase average yield through flood protection on 85,000 acres and through improved drainage on 11,000 acres to achieve this cost reduction.

With or without flood protection the number of agricultural workers in the Basin will decline from about 26,000 in 1969 to about 17,000 in 1980 or about 30 percent reduction. This is possible because of the continuing adoption of yield increasing and labor saving technology, e.g. better varieties and bigger equipment.

1/ See Chapter Three (page 3-27, first paragraph) for definition of "normal".

Table 8-16
Selected Variables Compared Under Normal Demands
With and Without Development for 19 MREA Counties, 1980

	Units	Normal Demand; Without Development	Normal Demand; With Development	Change	Percent Change
Crop Production Cost	$1000	83,255	83,082	-173	-.2
Total Value	$1000	179,218	179,218	-	-
Acres Used	1000 ac.	1,853	1,832	-21	-1
Acres Drained	1000 ac.	-	11.5	+11.5	-
Cost of Drainage	$1000	-	68.3	+68.3	-
Acres Flood Protected	1000 ac.	-	85.7	+85.7	-
Clean Tilled "e" Land Used 1/	1000 ac.	520	514	- 6	-1
Clean Tilled "w" Land Used 2/	1000 ac.	164	167	+ 3	+2
No. Farm Workers	No.	16,800	16,800	-	-
Farm Population	No.	72,600	72,600	-	-

Price Base 1972, Average Annual Dollars.
1/ "e" land is that in Class 2e, 3e, and 4e, i.e., having an erosion hazard.
2/ "w" land is that which has an inherent wetness hazard which requires treatment to develop its productivity potential.

Table 8-17
Selected Variables Compared Under Normal and
Maximum Demands Without Development for 19 MREA Counties, 1980

	Units	Normal Demand; Without Development	Maximum Production; No Development	Change	Percent Change
Crop Production Cost	$1000	83,255	139,000	+55,745	+67
Total Crop Value	$1000	179,000	292,000	112,782	+63
Acres Used	1000 ac.	1,853	3,042	+1,189	+64
Acres Drained	1000 ac.	-	-	-	-
Cost of Drainage	$1000	-	-	-	-
Acres Flood Protected	1000 ac.	-	-	-	-
Clean Tilled "e" Land Used	1000 ac.	520	970	+450	+85
Clean Tilled "w" Land Used	1000 ac.	164	332	+168	+100
No. Farm Workers	No.	17,800	21,350	+4,550	+27
Farm Population	No.	72,600	92,200	+19,600	+27

Price Base 1972, Average Annual Dollars

Table 8-18
Selected Variables Compared Under Maximum Demands With and Without Development for 19 MREA Counties, 1980

	Units	Maximum Production Without Development	Maximum Production; With Development	Change	Percent Change
Crop Production Cost	$1000	139,000	156,000	+17,000	+12
Total Crop Value	$1000	292,000	311,000	+19,000	+ 7
Acres Used	1000 ac.	3,042	3,042	-	-
Acres Drainage Implied By LP Model	1000 ac.	-	214	+ 214	-
Cost of Drainage	$1000	-	3,436	+ 3,436	-
Acres Flood Protected Implied by LP Model	1000 ac.	-	128.7	+ 128.7	-
Clean Tilled "e" Land Used 1/	1000 ac.	970	937	- 30	- 3
Clean Tilled "w" Land Used 2/	1000 ac.	332	401	+ 69	+21
No. Farm Workers	No.	21,350	21,700	+ 350	+ 1.6
Farm Populations	No.	92,200	93,740	+ 1,540	+ 1.7

Price Base 1972, Average Annual Dollars

1/ "e" land is that in Classes 2e, 3e, and 4e, i.e., having an erosion hazard.

2/ "w" land is that which has an inherent wetness hazard which requires treatment to develop its productivity potential.

Projected total capability of the resources was also analyzed. In comparison with normal projections the following conclusions can be drawn from the data available (Table 8-17).

1. The Basin could increase total agricultural output by 50 percent above the normal projected levels.

2. By 2020, presently available agricultural land will be reduced from 3,044,000 acres to about 2,771,000 acres. Thus by 2020 the maximum potential of the Basin will be about 40 percent greater than the normal projected demand.

3. If the Basin were producing at its maximum potential by 1980, the number of farm workers would decline by about 20 percent rather than the 30 percent expected under normal demands. Accordingly, there would be less decline in the rural farm population if there was a surge in demand for agricultural products.

4. About 85 percent more class 2e, 3e, and 4e soils would be used in clean tilled crops if the Basin were producing at maximum. This would increase the sediment load in streams. A subsidized, accelerated land treatment program as proposed in Alternative III would very likely be needed to help alleviate the erosion and sediment problem.

The foregoing impacts will occur under maximum potential levels of production whether or not flood prevention measures are installed. If flood prevention measures are installed and irrigation water supplies are developed as needed to maximize production the following impacts relative to the previous four impacts can be expected:

1. A seven percent increase in production could be obtained in exchange for about 200,000 acres of partial or full drainage, reduced flood risk on 100,000 acres and 60,000 acres of irrigation on corn, soybeans, and alfalfa.

2. A three percent reduction in acreage cf erodible land in clean tilled crops and an increase of about 20 percent in clean tilled crops in "w" land attributed to drainage and flood protection.

3. Employment increase would be negligible.

The additional economic impact induced by the multiplier effect would be significant as the Basin approached maximum production. For example, in obtaining the additional 50 percent increase in agricultural output, farmers will purchase about 50 percent more seed and fertilizer. Some types of inputs will increase less than 50 percent due to economies of scale, e.g., the same tractor may be used to farm 150 acres rather than 100 acres.

Plants processing agricultural products would also require more inputs including labor.

Alternative I projects would raise yields by 20 percent on about 17,000 acres of flood hazard land. From the regional viewpoint, i.e., the people benefited within the Basin, the agricultural benefits are $390,000 annually.

Tables 8-1, 8-2, 8-3, and 8-4 summarize the regional impacts of constructing Alternative I projects which are feasible under current programs. The total cost of installing all projects is estimated at $26.8 million. Of this, $16.3 million is for project construction and would provide about 800 man-years of direct employment over the construction period. Some of this labor may be brought in from outside the Basin by construction firms. Since much construction equipment is manufactured in Ohio, the multiplier effect from construction in Ohio should be similar to the U.S. which is 2.4. Therefore, the total Ohio impact of constructing Alternative I projects would be about $35,000,000. The multiplier effect within the Basin, however, will be much less because few of the industries supply construction inputs are located within the Muskingum Basin. There will be considerable leakage of the initial $16,000,000 from the Basin when construction firms go outside the Basin to obtain labor, equipment, and materials. The multiplier within the Basin is likely to be less than 1.5 both for employment and dollar value of construction.

Alternative I will provide about 400,000 recreation visitor days if the associated facilities are developed. However, as indicated in Chapter three, the need for large amounts of boating will not develop until after

2000. The economic impact of recreation is not likely to be significant in the short term, i.e., by 1980. However, by 2020 Alternative I projects may be needed to help meet the recreation demand.

Single purpose structures for municipal and industrial water supplies as proposed under Alternative II can have large favorable impacts on the economy of a community where water supply has discouraged industry from moving in. Financial aid to communities must be available but decisions to proceed with opportunities suggested under Alternative II will require impact studies when as there is sufficient local interest to implement them.

Table 8-5, 8-6, 8-7, and 8-8 show local benefits under Alternative II for single purpose projects. Total construction cost is estimated about $12,000,000. Direct employment generated by construction is estimated at 700 man-years. Again as in Alternative I most of this will be supplied from within the Basin but some will be brought in by outside construction firms. Equipment and material purchases from outside the Basin will cause leakages resulting in a multiplier within the Basin of 1.5 or less. The total impact on industry sales generated by installation of the project is estimated to be 18,000,000.

The major impact of Alternative III would be minimizing of environmental conflicts. It would reduce soil loss and sediment in streams through the resulting subsidized accelerated land treatment. Removal of flood plain lands from agricultural production by purchase would increase production costs of the normal demand level by three percent. The national efficiency loss would be about $280,000. The local impact would be felt primarily by owners and operators of flood plain land whether it was for agriculture or other purposes.

Recreationists would benefit by the existence of large amounts of public land adjacent to streams.

Flood hazard studies and the flood insurance program under Alternative III would make it possible for flood plain owners in affected cities to utilize some portions of the flood plain at a reduced risk. The risk would be

spread among insured users of the flood plain. This might result in greater benefits per dollar invested than would a structural program to reduce flood damage.

C. Recommended Short Range Plan

This report makes no specific recommendation for a long range plan for the Muskingum River Basin. This is not done in deference to the need for such a plan but rather in the interest of obtaining a comprehensive plan mutually agreeable to all concerned. In view of rapidly changing concepts in resource planning and with the many divergent interests in the Basin, a short range plan is recommended while a long range plan is formulated. The choices displayed in this study should offer sufficient latitude for development of the long range comprehensive plan within the next five years. Therefore, a short range program is being recommended for installation during this period.

The short range plan is taken from the four alternatives presented. The plan includes accelerated land treatment, flood hazard studies, and a limited amount of construction in projects presently authorized. The plan is not intended to have major impacts or commit the Basin to any sweeping development change but rather to function as a caretaker program until the alternatives set forth in this study can be carefully considered and a long range plan formulated and instituted.

Conservation treatment measures during this interim period will be accelerated by nearly 100,000 acres annually and include practices to reduce erosion, improve moisture absorption, reduce storm runoff, reduce soil fertility losses, increase production and improve aquatic and wildlife habitat. The measures will be applied to cropland, pastureland and forest land and will cost over $12.2 million with $2.6 million being technical assistance.

Flood hazard studies are recommended for the communities of Shelby, Loudonville, Millersburg, Minerva, Byesville, and Cambridge and the intervening area between the latter two communities (Map 8-5). These studies will provide a basis for a flood insurance program, help

regulate development in flood prone areas and implement local land use and management in flood plain areas. The estimated cost for these studies is $1.6 million.

Presently there are two PL-566 watershed projects authorized for construction and one authorized for planning in the Basin. It is recommended that these projects be continued. Buffalo Creek and Chippewa Creek are authorized for construction and represent a total installation cost of over $4.5 million. The South Fork of the Licking is currently authorized for planning.

Total cost for this interim plan is estimated to be in excess of $18,400,000 (see Tables 8-19, 8-21 and 8-22). The broadest impacts will result from the conservation land treatment program. It will result in reduced erosion, sediment, stream turbidity and pollution. It will improve farm efficiency and production and reduce fertilizer requirements. It will also improve the fish and wildlife habitat.

Estimated total annual benefits from the two watershed projects is $300,000. These developments are expected to have some impact on employment. The greatest economic impact will be in those areas where construction is carried out.

Reduction in flooding, application of resources development measures, and technological advancements should increase agricultural production and have a stabilizing effect on farm income. The effect of these development measures on agricultural income combined with income generated from a larger volume of production should strengthen the economic position of farmers in the two watersheds.

The construction activities will cause the greatest amount of environmental damages. Dust, noise, fumes, and other unpleasant pollutants will occur with active construction. The recovery of disturbed ecosystems and habitats will take longer. Some environmental features will be altered permanently.

Table 8-19
Summary of Land Treatment Costs
Short Range Plan
Muskingum River Basin, Ohio

Sheet 1 of 2

Conservation Treatment Practices	Acres to be Treated During 5-year Period	Federal Costs	Other Funds	Total Cost
Cropland				
Annual Cover	12,700	-	$ 15,200	$ 15,200
Sod in Rotation	55,700	-	-	-
Strip, Terracing and Diversions	117,600	-	1,176,000	1,176,000
Contouring Only	21,500	-	5,400	5,400
Permanent Cover	8,400	-	29,400	29,400
Subtotal	215,900	-	$1,226,000	$1,226,000
Pasture				
Protection Only	9,300	-	$ 325,500	$ 325,000
Improvement Only	82,400	-	2,884,000	2,884,000
Brush Control	31,600	-	1,106,000	1,106,000
Reestablishment of Vegetative Cover	12,600	-	630,000	630,000
Reestablishment of Cover and Brush Control	25,300	-	1,265,000	1,265,000
Subtotal	161,200	-	$6,210,500	$6,210,500

Table 8-19 cont'd

Sheet 2 of 2

Conservation Treatment Practices	Acres to be Treated During 5-year Period	Federal Costs	Other Funds	Total Cost
Forest Land				
Tree Planting	24,000	-	$ 960,000	$ 960,000
Timber Stand Imp.	20,000	-	712,800	712,800
Grazing Control	12,000	-	300,000	300,000
Harvest Cutting	41,200	-	205,400	205,400
Erosion Control	10,200	-	25,500	25,500
Subtotal	107,400	-	$ 2,203,700	$ 2,203,700
Technical Assistance				
Soil Conservation Service	-	$1,268,300	-	$ 1,268,300
Forest Service	-	1,336,700	-	1,336,700
Subtotal	-	$2,605,000	-	$ 2,605,000
Total Cost for Land Treatment Program	-	$2,605,000	$ 9,640,200	$12,245,200

Price Base 1972

Table 8-20

Physical Data For Feasible Watersheds
Short Range
Muskingum River Basin, Ohio

Watershed	Drainage Area (Sq. Miles)	Structures Proposed (Numbered)	Multi-Purpose Dams (Number)	Length of Channel Work (Miles)
Buffalo Creek.	50.2	3	1	8.7
Chippewa Creek	188.0	8	0	33.2

Table 8-21
Distribution of Structural Costs
Short Range Plan
Muskingum River Basin, Ohio

Watershed	Construction	Installation Services & Project Administration	Land Easements	Total Installation
Buffalo Creek	905,100	312,700	190,000	1,407,800
Chippewa Creek	2,014,000	592,000	518,800	3,124,800
TOTALS	2,919,100	904,700	708,800	4,532,600

Price Base: Buffalo Creek 1972 - Chippewa Creek 1970

Table 8-22
Comparison of Benefits and Cost for Structural Measures
Short Range Plan
Muskingum River Basin, Ohio

Watershed	Damage Reduction	More Intensive Use	Municipal & Industrial Water Supply	Redevel-opment	Secon-dary	Total Annual Benefits	Average Annual Costs1/	Benefit Cost Ratio
Buffalo Creek	41,300	12,300	3,300	25,000	6,300	88,200	84,000	1.05:1.0
Chippewa Creek	154,900	38,000	-	-	18,800	211,700	138,300	1.53:1.0
TOTAL	196,200	50,300	3,300	25,000	25,100	299,900	222,300	1.35:1.0

1/ Interest Rate: Buffalo Creek 5 7/8 percent; Chippewa Creek as reflected in the Supplemented Plan.

SHORT RANGE PLAN

MUSKINGUM RIVER BASIN

OHIO

MAP 8-5

SOURCE: FAMILY OF MAPS SCS DRAWING NO. 5,R-32,783 (1-30-74) AND INFORMATION FROM FIELD TECHNICIANS. TRANSVERSE MERCATOR PROJECTION.

9-12-74
5,P-34,383

USDA SCS-LINCOLN, NEBR. 1974

D. The Long Range Comprehensive Plan

A proposed plan of development should include provisions for conservation, development, and use of the water and related land resources of the Muskingum River Basin consistent with the interests of the local people, the state, and the nation. Basic elements of a plan should include: (1) land use and conservation treatment measures to be installed by landowners and operators with an anticipated subsidized program on some measures, (2) development of watershed projects to provide flood prevention, water storage for recreation, municipal and industrial water quality, and fish and wildlife purposes, (3) flood hazard studies to delineate flood prone areas and regulate land use and development and (4) improve the overall environmental quality of the Basin.

A comprehensive plan of development should have as one of its primary elements an accelerated land treatment program throughout the entire Muskingum Basin. This would include adequately treating all crop and pasture lands with assistance from current cost sharing programs and a subsidized land treatment program. All measures completed would protect the soil resource base, improve environmental quality, insure the continuation of adequate farm and timber production to meet present and future projected needs, and aid in the development of recreational opportunities.

Land treatment measures are necessary to the success of an overall development plan. The subsidized or additional federal funds of going programs would be useful to carry out such an accelerated treatment program.

Flood hazard studies are proposed in 39 communities where urban flooding is a problem and development is underway or will be in the near future. These technical studies are needed to control development in flood-prone areas and implement local flood plain management.

Development of nine watershed projects within the Basin is also proposed. They would reduce flood damages, provide water storage for recreation, pollution abatement, fish and wildlife, and municipal and industrial water supply. The development of these watersheds would

increase the efficiency of agricultural production, provide for additional municipal water supply, improve water quality, help raise the per capita income of Basin residents, and strengthen local communities.

Tables 8-23 and 8-24 show a comparison between the four alternatives. The Tables follow the "Principle and Standards" format. Since the plans were not formulated under this procedure, information gaps exist. Where information was not readily available or no evaluation completed, the spaces were left blank or the best possible estimate was given.

Table 8-23

Capability of Alternative Plans to Satisfy Component Needs1/
Muskingum River Basin, Ohio

OBJECTIVES			ALTERNATIVE PLANS - COMPONENT NEEDS PROVIDED AND REMAINING							
Component Needs			I		II		III		IV	
Description	Unit	Quantity	Provides	Remaining	Provides	Remaining	Provides	Remaining	Provides	Remaining
NED										
Flood Damage Reduction	Annual Damages	$3,075,800	1,463,100	1,612,700	1,417,600	1,658,200	0	3,075,800 2/	1,221,800	1,854,000
Water Supply for Municipalities	No. of Municipalities	16	5	11	12	4	0	16	12	4
Cropland Treatment Measures	Acres	799,700	532,600	267,100	532,600	267,100	799,700	0	799,700	0
Pastureland Treatment Measures	Acres	614,200	398,100	216,100	398,100	216,100	597,800	16,400	597,800	16,400
Forest Land Treatment Measures	Acres	1,918,500	268,600	1,649,900	268,600	1,649,900	395,000	1,523,500	395,000	1,523,500
Drainage Measures	Acres	295,000	0	295,000	0	295,000	0	295,000	0	295,000

Table 8-23 cont'd

Sheet 2 of 2

OBJECTIVES Component Needs			ALTERNATIVE PLANS - COMPONENT NEEDS PROVIDED AND REMAINING							
			I		II		III		IV	
Description	Unit	Quantity	Provides	Remaining	Provides	Remaining	Provides	Remaining	Provides	Remaining
EQ										
Reclamation of Stripmine Land	Acres	80,000	0	80,000	0	80,000	80,000	0	80,000	0
Wildlife Habitat Improvement	Acres	125,000	0	125,000	0	125,000	0	125,000	0	125,000

1/ Alternative Plans were not formulated under "Principle and Standards" Procedure.

2/ Floodwater damages were not evaluated. Instead agricultural land flooded by the two year storm would be purchased and used for recreation and wildlife purposes.

Table 8-24

Summary Comparison Between Alternative Plans1/
Muskingum River Basin, Ohio

Sheet 1 of 5

Accounts	Alternative I	Alternative II	Alternative III	Alternative IV
	(Average Annual)			(Average Annual)
I. National Economic Development				
A. Beneficial Effects				
1. Flood Prevention	$ 1,495,400	$ 1,432,600	$ -	$ 1,221,800
2. Recreation	620,700	-	-	538,200
3. Municipal and Industrial Water Supply	285,900	648,5002/	-	648,5002/
4. Redevelopment and Secondary Effects	405,500	300,300	-	334,500
5. Land Treatment Systems3/	-	-	-	-
6. Flood Hazard Studies	-	-	39 Communities 4/	39 Communities4/
7. Flood Plain Purchase	-	-	- 4/	-
B. Adverse Effects				
1. Installation Costs	1,631,300	1,182,500	-	1,311,000
2. Municipal and Industrial Water Supply Costs	5/	648,500	-	648,500
3. Land Treatment Costs3/	($30,337,900)	($30,337,900)	($49,330,800)	($49,330,800)
4. Flood Plain Purchase4/	-	-	($47,200,000)	-
5. Flood Hazard Studies4/	-	-	($ 9,000,000)	($ 9,000,000)
C. Net Beneficial Effects	1,176,200	550,400	10/	783,500

Table 8-24 cont'd

Accounts	Alternative I	Alternative II	Alternative III	Alternative IV
II. Environmental Quality				
A. Beneficial and Adverse Effects				
1. Reclaim Stripmine Land	-	--	80,000	80,000
2. Reduce Erosion	72,700 Acres	72,700 Acres	109,000 Acres	109,000 Acres
3. Disrupt Aquatic Eco-systems of Natural Streams	43 Miles	38 Miles	-	29.3 Miles
4. Disrupt Wildlife Hab Habitat by Installa-tion of Structures	44 Structures	46 Structures	-	50 Structures
5. Disrupt Rural Environ-ment by Public Access to Recreation Facili-ties	620,700 Visitor Days	-	-	538,200 Visitor Days
6. Flood Hazard Studies to Control Flood Plain Development and Use	-	-	39 Communities	39 Communities
7. Purchase of Flood Plain Land for Wildlife Cover and Recreational Uses	-	-	104,900 Acres	-
8. Install Land Treatment Measures on Cropland, Pasture Land and Forest Land	1,199,300 Acres	1,199,300 Acres	1,792,500 Acres	1,792,500 Acres

Table 8-24 cont'd

Accounts	Alternative I	Alternative II	Alternative III	Alternative IV
	(Average Annual)			(Average Annual)
III. Regional Development, State of Ohio				
A. Beneficial Effects				
1. Flood Prevention	1,495,400	1,432,600	-	1,221,800
2. Recreation	620,700	-	-	538,200
3. Municipal and Industrial Water Supply	285,900	648,5002/	-	648,5002/
4. Land Treatment System7/	-	-	-	-
5. Redevelopment and Secondary Effects	405,500	300,300	-	334,500
6. Flood Hazard Studies	-	-	39 Communities4/	39 Communities4/
7. Flood Plain Purchase	-	-	4/	-
B. Adverse Effects				
1. Installation Costs	1,631,3006/	315,700	-	1,311,0006/
2. Municipal and Industrial Water Supply Costs	5/	324,500	-	324,500
3. Land Treatment Costs7/	(23,864,900)	(23,864,900)	($31,908,600)	(31,908,600)
4. Flood Hazard Studies4/	-	-	(9,000,000)	(9,000,000)
5. Flood Plain Purchase4/	-	-	(47,200,000)	(47,200,000)
C. Net Beneficial Effects	10/	1,741,200	10/	10/

Table 8-24 cont'd

Accounts	Alternative I	Alternative II	Alternative III	Alternative IV
III. Regional Development cont'd				
D. Employment 8/				
1. Project Construction	163 Skilled Jobs for 1 yr.	118 Skilled Jobs for 1 yr.	-	143 Skilled Jobs for 1 yr.
	245 Semi-Skilled Jobs for 1 yr.	178 Semi-Skilled Jobs for 1 yr.	-	215 Semi-Skilled Jobs for 1 year.
2. Project O&M	2.5 Permanent Semi-Skilled Jobs	1.5 Permanent Semi-Skilled Jobs	-	1.8 Permanent Semi-Skilled Jobs
3. Water Supply Construction	9/	54 Skilled Jobs for 1 yr.	-	54 Skilled Jobs for 1 year.
		81 Semi-Skilled Jobs for 1 year.	-	81 Semi-Skilled Jobs for 1 year.
IV. Social Well-Being				
A. Create Low to Medium Income Permanent Jobs	2.5	1.5	-	1.8
B. Establish Jobs for 1 year.	543	296	-	493
C. Life, Health and Safety	Increase Output through Land Treatment Measures.	Increase Output through Land Treatment Measures.	Increase Output through Land Treatment Measures.	Increase Output through Land Treatment Measures.
	Reduce Frequency of flooding on 10 Streams	Reduce Frequency of Flooding on 8 Streams		Reduce Frequency of Flooding on 5 Streams.

Table 8-24 cont'd

Accounts	Alternative I	Alternative II	Alternative III	Alternative IV
IV. Social Well-Being Cont'd				
C. Life, Health, and Safety	Provide Water Supply to 5 Communities	Provide Water Supply to 12 Communities	Provide Restricted Use and Development of Flood Prone Land	Provide Water Supply to 12 Communities. Provide Restricted Use and Development of Flood Prone Land.
D. Recreational Activities	Provide 620,700 Recreational Visitor Days			Provide 538,200 Recreational Visitor Days

1/ Alternative Plans were not formulated under "Principle and Standards" procedure. Some areas were left blanked because either they did not apply to the alternative or they were not evaluated.
2/ Benefits were not evaluated and therefore, were assumed to be equal to the costs. This applies to 12 water supply sites.
3/ Land treatment benefits were not evaluated. The total estimated land treatment costs are shown for each alternative in parenthesis under adverse effects.
4/ Benefits were not evaluated. Total estimated costs for flood hazard studies and flood plain purchase are shown under adverse effects.
5/ Municipal and industrial water supply cost is included in the installation costs.
6/ Installation costs could not be separated between the state and the rest of the nation.
7/ Land treatment benefits were not evaluated. Land treatment costs in parenthesis under adverse effects are the costs that will be borne by the region.
8/ Employment statistics presented are purely estimates.
9/ Employment from water supply construction is included in project construction.
10/ Net beneficial effects cannot be determined.

Chapter 9

COORDINATION AND PROGRAMS FOR FUTURE DEVELOPMENT

MUSKINGUM RIVER BASIN

Chapter 9. Coordination and Programs for Future Development

A. Department of Agriculture

B. Other Agency Programs

C. Potential Developments Needing Further Coordination with Other Agencies.

D. New Programs or Modification of Existing Programs

A. U.S. Department of Agriculture

Agencies responsible for administration of natural resource programs in the Basin include the Soil Conservation Service, Farmers Home Administration, the Agricultural Stabilization and Conservation Service, and the U.S. Forest Service. Basin development will require some reorientation of these agency programs to accelerate land treatment, improve environmental quality, and provide water resource development.

Request that the Agricultural Stabilization and Conservation Service be authorized to increase the rate of application of selected practices that are most effective in reducing erosion and sediment damage. These measures would do much to improve water quality, agricultural efficiency, and aesthetics of the entire area with no significant administrative or organizational impact.

Request additional obligational authority be granted to the Farmers Home Administration. This would include farm ownership, soil and water conservation, forestry and operating loans, plus loans for water and sewer projects, soil waste disposal systems, and land rights acquistion for water resource development. The U.S. Forest Service and Soil Conservation Service should adjust their priorities in planning and installing program measures. Public Law 566, Public Law 46, Cooperative Forestry Programs, and the Resource Conservation and Development Program provide technical and cost-sharing assistance for measures which primarily involve flood control, irrigation, drainage, and land treatment. However, in order to facilitate the portions of the programs dealing with recreation, fish and wildlife, water supplies, and water quality additional authorization may be required.

B. Other Agency Programs

Most Corps of Engineer flood control projects must be authorized by an act of Congress. However, construction cannot be started until funds for the project are appropriated by Congress. Some smaller projects and certain emergency works can be accomplished under the

continuing authority of the Chief of Engineers. Five projects in the Muskingum Basin have been authorized for future construction.

(1) Millersburg Reservoir would be located on Killbuck Creek immediately upstream from Millersburg and would control 381 square miles of the 613 square mile drainage area. There would be no permanent pool and the entire capacity of 77,000 acre-feet, equivalent to 3.8 inches of runoff, would be allocated to flood control. The capacity is limited because a further increase in the size of the reservoir would inundate portions of the City of Wooster and the main line of the Pennsylvania Railroad. The project has been placed on inactive status by the Corps of Engineers.

(2) North Branch of Kokosing Reservoir was authorized by Congress in 1962. The reservoir will be located on the North Branch of the Kokosing River about two miles northwest of Fredericktown. It would provide about 13,842 acre-feet of flood storage, equivalent to 5.9 inches of runoff from the 44.5 square-mile upstream drainage area. A minimum pool of 154 acres would provide sediment storage and some recreation. Estimated project cost is $6.5 million. The lake became operational in 1972.

This project combined with benefits provided by State-owned Knox Lake and the completed Mount Vernon local protection project will eliminate damages at Mount Vernon and Fredericktown from a flood as great as that of January 1959.

(3) Frazeysburg Reservoir would be located on Wakatomika Creek near Frazeysburg and would control 139 square miles of the 234 square mile drainage area. The reservoir would benefit Frazeysburg and downstream areas along Wakatomika Creek and would reduce flood heights at Zanesville and other downstream areas along the Muskingum River. Project is presently in a deferred status.

(4) Zanesville Local Protection Project would provide additional local protection for Zanesville by channel improvements, levees flood walls, and provision for

internal drainage. However, the need for such protection has been greatly reduced by the protection afforded by Dillon Reservoir. The Corps of Engineers considers this project currently inactive.

(5) The Utica Reservoir Project and improvement and modification of the Newark Local Protection Project were authorized for construction by the Flood Control Act of 1968. As authorized Utica dam would be located on North Fork, 18.6 miles above the junction with Licking River and would control a drainage area of 113.8 square miles. Storage capacity would be 82,000 acre-feet, which is equal to 13.5 inches in runoff. The project would be operated for flood control, recreation, fish and wildlife enhancement, stream flow regulation, and water supply. The authorized work at Newark comprises interior drainage improvements, modifications of North Fork channel, and diversion of Log Pond Run. The projects are in the advance engineering and design stage.

C. Potential Developments Needing Further Coordination with Other Agencies

The Wolf Creek Watershed, for which a PL-566 application has been received, was studied by the Soil Conservation Service, the Forest Service, and the Economic Research Service under authority of Section 206 of the Appalachian Regional Development Act of 1965. The Wakatomika and Moxahala-Jonathan Creek Watersheds were also investigated under the same programs.

D. New Programs or Modification of Existing Programs

The Rural Development Act of 1972, Public Law 92-419 provides the Secretary of Agriculture with new authorities in rural development. However, it is undetermined as to which agencies within the Department will be designated to administer certain of the new provisions. It is further undetermined, at this time, as to the level of funding and personnel.

The amendments under Titles II and III of the Act further broaden and increase the effectiveness of small watershed and RC&D projects for enhancement of life in rural America, and provide a continuing land inventory and monitoring program.

These amendments provide additional authorities to the Secretary in assisting local organizations to plan and carry out needed development.

The Land Inventory and Monitoring Program meets a continuing need for the guidance of community development for balanced rural-urban growth. It provides a basis for national decisions regarding the use and treatment of the nation's land, water, vegetation, and related natural resources.

The Rural Environmental Conservation Program (RECP) has been initiated by the Agricultural Stabilization and Conservation Service to provide cost-share assistance to landowners carrying out conservation practices on their land. Technical assistance will be provided by the Soil Conservation Service for all practices except forestry which will be serviced by the Forest Service.

RECP is an umbrella program with three phases: (1) an annual program within which cost-sharing is by individual practices for one year; (2) Long Term Agreements (LTA) based on a conservation plan for the entire farm. The plan would be prepared with help from the Soil Conservation Service and approved by the local Soil and Water Conservation District. Contracts would be for a three to ten year period and assure the land owner cost-sharing for planned practices; and (3) Forestry Incentive Program (FIP) would cost-share for tree planting and timber stand improvement in designated counties to accelerate timber production.